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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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The T.U.C. and the Future of Industry.

It is very difficult for ordinary people to understand the point of view taken by the speakers at the annual Trades Union Congress, which has just concluded at Nottingham. It is natural that men whose jobs are threatened by industrial changes should be concerned with the possibilities of the future, and that the sympathy felt by the community is a very real thing is shown by the development of a series of social services unequalled anywhere in the world. With the relative degree of security so ensured, it might be thought that the ordinary workman would show a willingness to adventure, try new jobs and generally aid the employer in meeting the needs of the times. But we look in vain for any such spirit at the T.U.C. On the contrary, for the discussions appear to be based on a knowledge of economics that is negligible.

Thus the introduction of labour-saving machinery would be met by the introduction of a forty-hour working week, with six-hour shifts for process and shift workers. Pensions at 60 or 65 and compensation for displaced workers were also advocated. It seems so foolish to thinking people to meet a situation like the present by increasing wages, reducing hours and providing further social services. To remove unemployment, what we need is to increase spending power, which means doing more work for the same wages. If the introduction of machinery is to be followed by shorter shifts at the same wages the whole economic motive for the introduction of improved plant—to increase efficiency, lower selling prices, increase demand, thence increased employment all round—is defeated at the beginning. Many of the resolutions brought before the Congress from year to year are rather in the nature of pious hopes than anything, but the proceedings at this year's meeting have been disappointing to those whose task is to administer industry and who had begun to hope that some sort of realism was beginning to permeate the workers as a whole.

The T.U.C., in fact, is not representative of the spirit of industry, which is better illustrated by the action of workers in a Lancashire mill offering to take a 5 per cent. reduction in wages in order to pay off bank debentures as an alternative to closing the mill. From the beginning of the industrial system the process of economising in production has gone on. Only recently have we learned to call it rationalisation. The result has been an enormous increase in the standard of living all round. The question the worker must ask himself is, how can I hope to take more out of industry unless by brawn or brain I put more into it? How, in fact, can I hope to continue to take as much if in other countries men who take less can do the same work at least as acceptable to the buyer of the product?

The Situation in the German Foundry Industry.

Amongst the most interesting annual events which we report is the annual meeting of the German Iron-Foundry Owners' Federation. For 60 years that body has been making serious efforts to make the industry as a whole a lucrative one. Whether it has been a 100 per cent. success or not is difficult to say, but one outstanding fact is that Germany, with a much greater population than Britain, has two-thirds the number of ironfoundries, which naturally indicates that, with an equal industrial development and export trade, they must be on an average larger than here.

It is customary at these annual meetings to include a few technical Papers, surveys of the markets and discussions on the reports of the various committees. This year there was an important contribution to the subject of special irons, of which Germany has always taken from Britain important consignments. Apparently a new iron has been developed, which contains a modicum of aluminium, and from this basis a theory is woven involving the production of small graphite nuclei and consequent good properties.

Dr. Geilenkirchen, in his address on "Rationalisation in Germany," admitted that its expected success had not been achieved "because the economies effected had either been swallowed up in the payment of interest on the loans for the purpose of carrying out this rationalisation or had been anticipated by the increases in wages." We cannot help but comment that true rationalisation should have taken cognisance of both these factors. The factor which is beyond the normal ken is fall in consumption, which, apparently, is determined by a fall in commodity prices, which, in turn, is influenced in some obscure fashion by gold movements. We confess to a little difficulty when dealing with Dr. Geilenkirchen's nomenclature; he refers quite lengthily to the "commercial" foundries—which term includes those firms which have to enter the market for their orders—as this term seemed exotic and "jobbing" does not quite fill the bill, we have coined the phrase "detached" foundries, which is meant to embrace all establishments which are neither attached to a blast furnace nor an engineering business.

Dr. Werner's address, as President, gives some notion as to the activities of his association, and indicates the valuable system of interlocking the various societies—technical, research and commercial activities. Unless this interlocking can be effected there is a grave danger that the work of one section may, through ignorance of the other's requirements, be against the best interests of the whole industry. The research interests, for instance, may desire to increase the number of and stiffen the demands in specifications for the purpose of giving the engineer greater confidence in cast products. The commercial side may have equally good grounds for retaining a "*status quo*."

Finally, Prof. Leidig's talk on "Economics" might easily have been given before a British audience, using a parallel set of figures. Germany and Great Britain apparently are suffering from the same type of industrial disease.

XUM

Norfolk Foundries.

We recently undertook a tour of a few typical foundries and engineering establishments in Norfolk. The visit was arranged by Mr. Kenneth S. Jewson, works manager of Messrs. Hobbies, Limited, of Dereham, to whom we are much indebted for the many courtesies shown us during the two days spent in the area.

The first foundry visited was that of the East Dereham Foundry, Limited, South Green Works, East Dereham, where Mr. E. W. Crane, the managing director, placed himself at our disposal. The foundry is quite small, but very busy. It is engaged on the manufacture of stove parts, firebars and builders' castings. No moulding machines have been installed, but an excellent production per man is maintained. The foundry is typical of a well-run jobbing foundry. It is neat, orderly, clean, well lit and there exists a real appreciation of modern methods. The cupola staging is served by an electric hoist, whilst a sand-blast tumbling barrel is installed in the fettling shop.

The next works visited was Cranes (Dereham), Limited, an associated company, which manufactures pressed-steel wheels, special lorry bodies and road-making machinery. The shops had plenty of work, including a fair amount for both British and foreign Governments.

Hobbies, Limited.

The foundry at Messrs. Hobbies, Limited, is to be reorganised in some essential features in the near future. For several years Mr. Jewson has been studying profoundly his operating costs, and now has data upon which to base his alterations. For the larger foundries, the economic arrangement of plant is a comparatively easy matter, but for those having small outputs many complications arise, such as the fact that one man may spend a portion of his time as a fettler and another portion as a sand-preparer. Thus one has to envisage the grouping of plant around a section of the foundry where the unskilled labourers can be concentrated, whilst bearing in mind that extensions would render such an arrangement unprofitable. The Hobbies foundry is exceptionally tidy and well lighted. It possesses a fair range of moulding machines of the hand-press variety, including a modern Berkshire machine, which cater for the fretwork section of the business. One of the most interesting sections of their work is that of architectural castings. Full use is made of pattern plates, both for the iron and non-ferrous castings. A sand-blast room and tumbling barrels have been installed in the fettling shop. An excellent skin is obtained, and the castings, many of which are machined all over, are particularly dense. The works are reasonably busy, and the operation of the regional electrification system will allow of better night illumination and no doubt introduce other alterations. Apart from the model machinery business, a fair volume of Air-Force work was going through the shops at the time of our visit.

The Foundry of Messrs. Boulton & Paul, Limited, Norwich.

The Foundry of Messrs. Hobbies, Limited, Dereham, Norfolk.

Boulton & Paul, Limited.

This famous Norwich works possesses a fair-sized foundry. Unlike most, it manages, and manages very successfully, with only one cupola, which runs every day. For variety of work few foundries could show more than this. The floor was taken up with pianoforte frames, corporation castings, intricate cylinder work, gutters and firebars. The cupola—a 36-in. Constructional—sand-preparing and core-making plant are housed in one bay. The centre bay is devoted to moulding, and in a lean-to bay the castings are fettled. Raw materials are subjected to the closest possible laboratory control, and the waster loss is surprisingly low. Dr. Odgers acted as our chaperone, and, after leaving the foundry, conducted us through the wire-netting manufacturing departments. It should be remembered that Boulton & Paul has one of the largest wood-working departments in Great Britain, and as a result vast quantities of wood waste and sawdust are produced. A suction plant conveys these products to a wood-gas plant, where the wood is distilled and the gas used for heating the spelter pots. An interesting department is that devoted to drawing aeroplane constructional sections. The draw benches, using case-hardened mild steel as dies, have produced the vast quantities of reinforced tubular sections necessary for the construction of the R-type of airship.

The last visit to be made was to the aeroplane-erection works on the outskirts of Norwich. It is part and parcel of an aerodrome, and houses, in addition to the final assembly plants, the research and development departments.

Steel Used for Ornamentation of American Buildings.—New York's tallest skyscraper, 1,248 ft. high, the Empire State building, with its steel frame now erected above the half-way point, is utilising 300 tons of polished chrome-nickel corrosion-resisting sheets as exterior ornamentation, in the form of "window trim, ornamental sunbursts, store fronts and dirigible mooring mast." This metal is being fabricated in Canton, O., and is shipped to New York in boxboard cartons. It is a chrome-nickel steel, commonly referred to as 18-8, and contains 17-20 per cent. chromium, 7-10 per cent. nickel, less than 0.20 per cent. carbon, less than 0.50 per cent. manganese, over 0.50 per cent. silicon, and a maximum of 0.025 per cent. of sulphur and phosphorus.—"Steel."

Magnetically-Operated Moulding Machines.

AN IMPORTANT BRITISH DEVELOPMENT.

The foundry industry, until recently, had the choice of two direct motive powers for operating its moulding machines—hydraulic and pneumatic. The technical staff of the British Insulated Cables, Limited, of Prescot, Lancashire, after several years of experiments, have now perfected a system which utilises power from the mains through the intermediary of either solenoids or electromagnets. The system has been covered by patents in all countries. At the Prescot works two magnetic machines are in regular operation, and have certainly passed well out of the experimental stage. The later design of machine, shown in outline in Fig. 1 and illustrated in Figs. 2 and 3, was, on the occasion of our visit, making half-moulds for boxless castings. An excellent speed was being achieved, but, as is the case with every moulding machine, output is governed by adequacy of sand supply and box removal and handiness of tools. The external design, as will be noticed, resembles the Continental design of pressure machines for this work, and the operation of moulding is similar, but for the handling of the machine there is this difference: The machine is operated through a push-button control switch, which can be fitted in the most suitable position for the operator, either on or off the machine. This allows a current of 240 volts and about 80 amps. to energise the magnet for a second or so, bringing the pattern plate and box under the pressure head to receive the pressure from the energised magnet, which in the case of the machine shown in the illustration is approximately 5 tons. The mould is 17 in. dia. Thus, if a machine taking 17-in. dia. boxes makes a mould a minute for 8 hrs. a day, then power is being used for about 8 mins. a day. Calling this 15, and invoicing power at a penny per kw.-hr., it means that power is only costing 5d. per machine per day. It will also be noticed that this machine has only one magnet, and this is used for pressing the mould only; the stripping of the pattern being done automatically on the down stroke of the machine, as will be noticed from the illustration. The length of stroke on this machine is 4 in., but any stroke can be arranged for. Some moulds of deep draw require a slow-motion stripping, and this action is taken care of by the provision at the base of the machine of an oil dash-pot. Here either mechanical provision can be made for intensity of cushioning or the thickness of the oil used can be varied.

The machine illustrated is a solenoid type, and the magnetic portion is entirely enclosed, so that moisture or sand cannot get into the coil or working parts. The stroke of the machine can be adjusted in a moment from 0 to 4 in. by turning the nut underneath the pattern table.

It should be borne in mind that, whilst a simple pressure machine has been put into commission, it does not represent the alpha and omega of this development. For instance, we see no reason why, instead of using 25 h.p. to compress a volume of sand at 50 lbs. per sq. in. in one second, one could not emulate the jar-ramming machine by giving a series of bumps, using solenoids or magnets as the motive power.

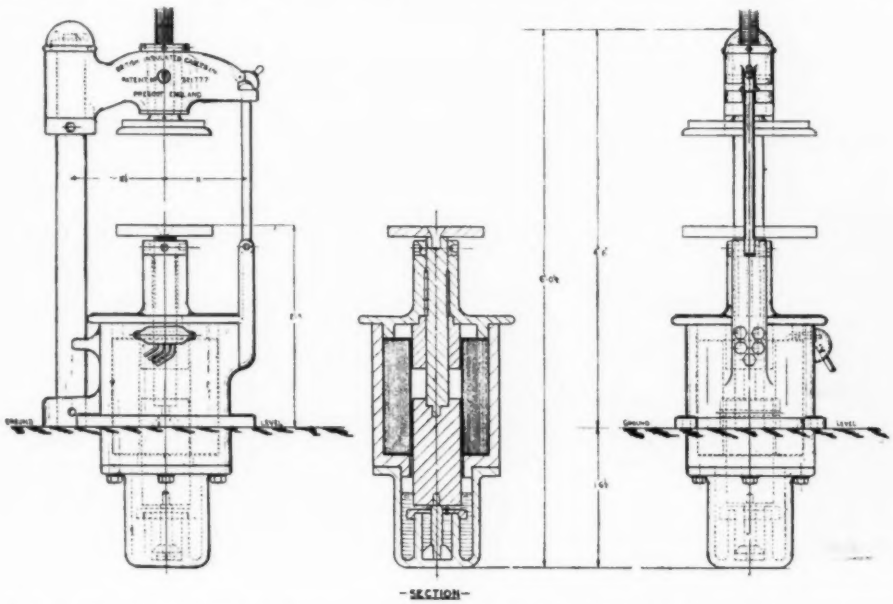

FIG. 1 SHOWS THE GENERAL ARRANGEMENT OF AN ELECTRO-MAGNETICALLY-ACTUATED MOULDING MACHINE. IT IS ARRANGED TO GIVE A 4-IN. STROKE FOR BOXES UP TO 18 IN. SQUARE, UTILISING A PRESSURE OF ABOUT 5 TONS.

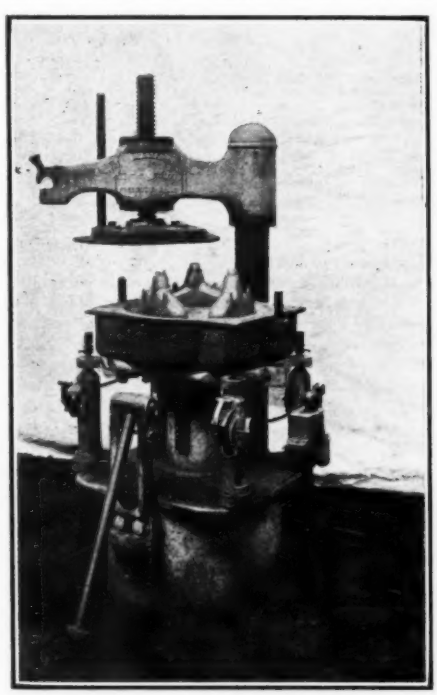

FIG. 2.—A MAGNETICALLY-OPERATED MOULDING MACHINE BY BRITISH INSULATED CABLES, LIMITED.

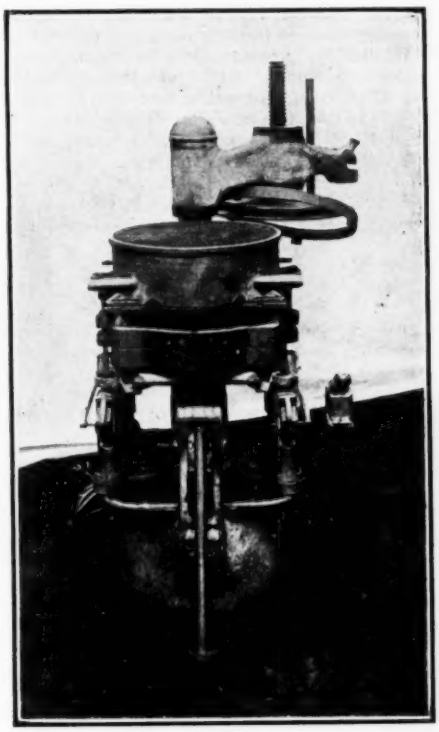

FIG. 3.—THIS MACHINE IS SET UP FOR MAKING BOXLESS MOULDS, UTILISING A SECOND MACHINE FOR REMOVING THE MOULD FROM THE BOX.

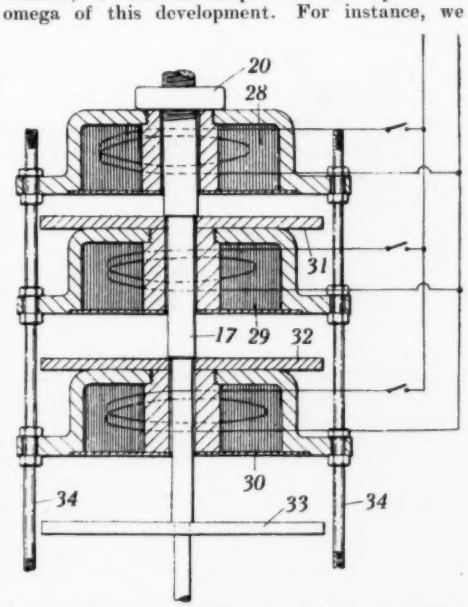

FIG. 4.—ARRANGEMENT FOR DEALING WITH DEEP PATTERNS. THE ARMATURES NOS. 31, 32 AND 33 ARE MOUNTED LOOSELY ON THE SPINDLE.

Again, where there is a deep pattern, requiring a much longer stroke than the one we saw in operation, which was about 4 in., then the engineers at the British Insulated Cable Company have provided for a series of solenoids attracting cores working within the coils so that each solenoid induces a portion of the total movement necessary. Fig. 4 shows a similar arrangement, but magnets are used in the place of solenoids.

Whilst the present machines are made for continuous current, it is, of course, possible to use alternating current direct or through convertors or rectifiers. Foundrymen will appreciate that past experience on air or hydraulic machines will not be lost on the magnetic type, as existing pattern plates and boxes, etc., can be used on the machine, and all operations are practically the same except that operation is by button control instead of moving a lever. The machines are to be fitted with electric vibrators.

The construction of the machines which we examined at Prescot impressed us as being robust and workmanlike. The whole of the working parts are totally enclosed. One of the machines had been working for 18 months, and had been given the roughest possible usage, but the electrical parts had not suffered a single breakdown.

It is realised by the firm that moulding machines are extremely diverse in character, no one model being universally applicable (if only by reason of size) to all repetition jobs, but they feel that this novel application of motive power is capable of expansion and adaptation to meet any demands put upon it. The present situation is that they are now in a position to put at least two models into production for the market, whilst further experiments and trials can be carried out for adaptation for specialised requirements. We congratulate the company in having placed a novel motive power in the hands of the foundrymen, and thank their staff, especially the foundry manager, Mr. T. W. Bullock, for according us facilities for inspecting the machines and for having helped us in the preparation of this article.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

British Pig-Iron Resources.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We beg to refer to your issue of September 4, page 170, wherein you have been good enough to publish certain particulars regarding our makes of pig-iron. Permit us, however, to point out that the blast temperature employed in making our "G. & R. T. Special" is not 1,500 deg. Fah., as stated in your journal, but 500 deg. Fah. only. You will note that in the "Remarks" column we state that a "Coddled" blast is used for this iron—it is, in fact, a semi-cold blast—and the published figure of 1,500 deg. Fah. is, therefore, inappropriate and misleading.—Yours, etc.,

G. & R. THOMAS, LIMITED,
WM. MUSGROVE, Director.

Hatherton Furnaces,
Bloxwich, Staffordshire.

Semi-Steel.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of September 4 you published an article by "Vallishe" and a leader criticising it. In your issue of September 11 you publish a letter, signed by "Riley." During the last twelve months you have also published numerous articles on steel-mix irons, written by Mr. McRae Smith, who is one of our most experienced cast-iron foundry metallurgists, having a real knowledge of steel-mix cast irons. I also strongly object to the description "Semi-Steel," as it is entirely misleading and incorrect, and is simply a "catch phrase." As you suggest, the inclusion of even the smallest proportion of any alloy into either iron or steel could justify describing such material as manganese, nickel or chromium steel or nickel or manganese-alloy iron. This could easily lend itself to fraudulent misrepresentation and must be strongly discouraged.

The correct description of cast iron melted in a cupola with scrap steel of any percentage added is "Steel-Mix Iron." It is not "semi-steel" at all.

Immediately steel is charged into a cupola and mixed with pig-iron and scrap cast iron and then melted with coke it picks up carbon, and, whilst the total carbon contained in the poured metal may be slightly lower, depending upon the amount of steel scrap in the charge, nevertheless, the result is not "semi-steel" but cast iron.

The best steel-mix cast iron is obtained by the well-known "Emmel" process, now being worked by some of the most important foundries in Great Britain and on the Continent with outstanding success. By this process up to 80 per cent. of scrap steel of defined quality is charged into the cupola with the pig-iron and various, but very necessary, alloys. It is certainly not cheaper nor is it as cheap to make or melt steel-mix cast irons, as the temperature necessary in the cupola to melt perfectly the steel charge must be higher and the coke consumption must, therefore, be greater.

It is impossible to pour a good steel-mix iron at a temperature below 1,450 deg. C., whereas most ordinary irons can be successfully poured at 1,300 to 1,350 deg. C. This higher pouring temperature is essential for all good quality grey cast irons such as "Perlit iron," which also contains up to 30 per cent. of steel scrap of good quality.

The very low tensile of 14.6 tons given by "Vallishe" for "semi-steel" is almost ridiculous, as "Perlit iron" averages 16 tons and "Emmel" iron averages 18 tons and goes as high as 26 tons tensile, and has an exceedingly high resistance to internal pressure even in the thinnest sections.

It appears evident that many of your readers rush into print without having read much of the valuable matter continuously published by your excellent journal, and their statements may be dangerously misleading.

All really new qualities of cast iron, which have any unusual value, should be clearly labelled as such, as only by this means can prospective buyers be assured of receiving what they are quite prepared to pay for. Otherwise, what is the value of any new process or quality of either cast iron or steel and what is gained by expensive research?—Yours, etc.,

JOHN A. SMEETON.

15, Victoria Street,
Westminster,
London, S.W.1.
September 13, 1930.

[At the present juncture it is best, when referring to mechanical tensile and transverse strengths to quote the average section to which they refer. Overstatement as to the average strength of cast iron in the larger sections is liable to do the foundrymen a disservice until the requirements of certain specifications are cleared up.—EDITOR.]

Boiler Explosions in 1929.—According to the report recently issued by the Board of Trade there were last year 88 boiler explosions which were the subject of inquiries under the Acts. Of the 88 explosions, 38 resulted in the loss of life or in personal injury, nine persons having been killed and 57 injured. The corresponding figures for 1928 were 62 boiler explosions, 24 resulting in loss of life or personal injury, 7 persons killed and 20 injured.

Random Shots.

The rivalry between Melbourne and Sydney is, as everybody knows, very acute, and the meeting of the arms of the great new bridge at Sydney being built by Dorman, Long, together with the recent Test Match result, has been responsible for an entirely new joke to the effect that Sydney is now three hours ahead of Melbourne, these being 'our Bay, 'our Bridge and 'our Bradman.

* * *

Did you see the remarks of Mr. W. M. Citrine, secretary of the Trades Union Congress, who has recently returned from a visit to Australia, Canada, South Africa and the United States? He said: "I do not think that we boast enough of our achievements in post-war reconstruction, in financial effort, and in the organisation of social services, which are second to none in the world. I have seen or heard of nothing comparable to them. . . . I return home with a deeper pride in the achievements of the Old Country and with a clearer appreciation of its influence and power in world affairs. . . ."

* * *

The death of Dr. Spooner, of Oxford, reminds us how extraordinary are the trivialities on which reputations are built up. An accidental transposition of initial letters made by him in giving out a hymn title in 1879 produced a laughable arrangement, and subsequent generations of undergraduates spent much time in devising other "Spoonerisms," attributed to him but more frequently due to the ingenuity of others. Thus, he once left Oxford by the "town drain," meaning "down train." He was said to go once looking for an inn called the Dull Man at Greenwich when he wanted the Green Man at Dulwich; he once complained to the verger of a church when strangers occupied his seat: "These people are occupewing my pie; sew them into another sheet." All this is probably undergraduate invention, as is the story of his absent-mindedly kissing the porter at a railway station and giving his wife sixpence, but he really did tell a young lady, who asked him if he liked bananas, that he really preferred the old-fashioned nightshirt.

* * *

Of other word-twisters, he spoke once of a "well-boiled icicle," and said that his luggage consisted of "two rags and a bug"; that the camel passed through the "knee of an idol."

* * *

The daily Press gave a great deal of space recently to a report, said to have been made by a retired American steel magnate whose name is unknown to me, on the British steel industry. He was reported as leaving Paris for London with the report in his pocket and as declining to discuss it before putting it before his British colleagues, but his proposals were then laid out in some detail. They involved the scrapping of all existing British blast furnaces, and their replacement by furnaces producing 1,000 tons per day, with coke-oven plant, on the coast near a deep-water harbour.

* * *

From subsequent reports it seemed uncertain whether the report had been commissioned from American or from British sources. From the reporters' information I should imagine that the British steel industry contains many men who have amused themselves during the past ten years drawing up similar reports.

* * *

I liked the story of a lady shopping at the greengrocer's and being offered some horseradish, which she declined to purchase, saying that they kept a car.

MARKSMAN.

High-Frequency Steel Furnaces.*

By D. F. Campbell.

The melting of steel in an ironless induction furnace has been generally recognised as an efficient and economical method of making tool steel under conditions similar to those of the crucible process, but there is no justification for supposing that the induction furnace is limited to the simple metallurgical operation of melting small quantities of high-class raw materials to produce tool steel.

A survey of the present status of the ironless induction furnace will show that its field of utility is much wider than is generally supposed. As is usually the case with new developments, it is supplementing certain processes, replacing various types of furnace in part, and though its limitations of size will prevent its application to certain operations requiring large ingots or castings, the rapidity of operation will have an important bearing on steelworks practice outside the melting shop. Ironless induction furnaces of the Ajax-Northrup type, having an hourly output of 20 to 25 cwts. (Fig. 1), have been remelting of manganese scrap; (*g*) the melting of hard materials such as tungsten carbide.

By the melting of high-class tool steels in acid-lined furnaces, to replace the crucible process (Fig. 2), a marked reduction in cost and a definite improvement in quality of many steels, especially those containing complex alloys, have been established.

For making tool steel, 5-cwt. furnaces melting one charge per hour are commonly used. These are considerably cheaper to operate than gas- or coal-fired crucible furnaces, and the labour is less costly and less difficult to obtain. In addition, certain qualities of steel containing complex mixtures of alloys can be made of a homogeneity unobtainable with the ordinary crucible furnace. A 5-cwt. furnace equipped with a high-frequency generator of 150 kw., operating day and night six days a week, has averaged 108 tons of ingots per month during a period of six months, at a consumption of just over 700 kw.-hr. per ton, measured on the incoming cable of the motor driving the generator.

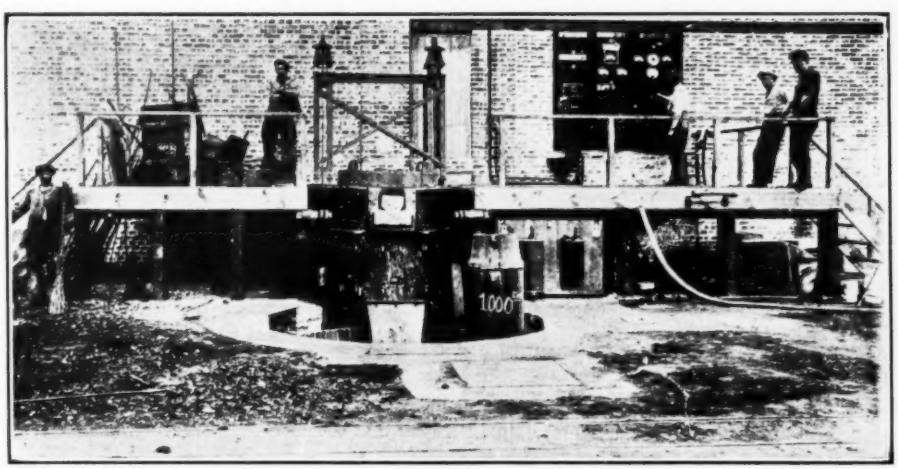

Fig. 1.—20- to 25-cwt. High-Frequency Furnace, producing 20 Tons per Day.

operated since July, 1929, and smaller units of 5 cwts. capacity (Fig. 2) have been producing steel regularly since October, 1927, when the first tool steel from the ironless induction furnace was produced on a commercial scale in a Sheffield steelworks.

At present the largest units are furnaces of 20 to 25 cwts. capacity per heat, giving an output of 20 tons per day, but the design of furnaces of 3 to 5 tons presents no technical difficulties, as many details of construction are easier in furnaces of large dimensions, while large motor-generator sets can be built to operate at lower speeds and their design is well within established practice. There appears to be no technical reason to prevent the construction of units of any size that is commercially practicable, though economic considerations indicate the probability that units of less than 15 to 25 tons will be adopted.

At present, the steel-making operations to which these furnaces have been applied are as follow: (*a*) The melting of high-class tool steels in acid-lined furnaces to replace the crucible process; (*b*) the melting of low-carbon steel and alloys; (*c*) the melting in an acid lining of rolling-mill scrap produced from steel made in basic-lined arc-furnaces; (*d*) the melting of heat-resisting steel and refractory chromium alloys; (*e*) the melting of nickel-chromium alloys; (*f*) the

* Abridged abstract of a Paper read before the Prague Meeting of the Iron and Steel Institute.

Official reception tests on ten consecutive heats, five of high-speed steel and five of stainless steel, gave the power consumption in 5-cwt. and 10-cwt. furnaces shown in Table I:—

Table I.—*Power Consumption.*

Heat.	Kw.-hr. (1,000 kg., 2,216 lbs.).	
	150-kw., 5-cwt. furnace.	300-kw., 10-cwt. furnace.
1	660	640
2	770	650
3	700	640
4	680	700
5	657	576
6	710	588
7	641	553
8	610	652
9	625	658
10	612	—
Average	666.5	628.5

The figures in Table I refer to melting in siliceous linings without refining. Many manufacturers of tool steel have found it convenient to have small furnace bodies of 1 to 2 cwts. capacity operated from the same electrical equipment as their larger units of 5 or 10 cwts. Such furnaces melt very rapidly, and are convenient for making small castings, experimental heats, or small quantities of special alloys for customers requiring quantities smaller than the capacity of the larger units.

The most convenient time for making a heat of high-class steel is 1 hr. for 3-cwt. furnaces, and about 1¼ to 1½ hr. in the case of 20- to 25-cwt. units. It does not seem to be advisable to work more quickly than this, owing to the time required to prepare moulds and cast ingots carefully. Faster melting is possible, but it is essential to allow a certain margin of time in high-class steel-making operations—a condition which does not apply so strictly in the case of mild steel for castings.

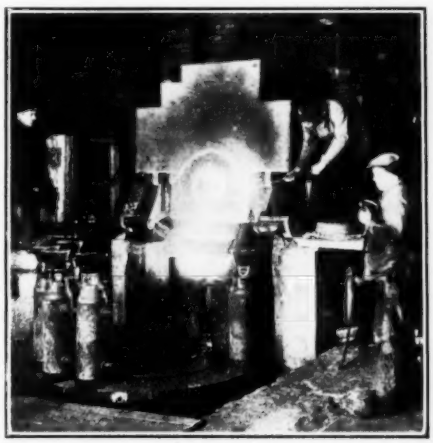

Fig. 2.—5-cwt. Furnace casting Ingots on Turn-table.

The electric furnace is used for melting steel and alloys requiring lower percentages of carbon than those obtainable by the crucible or arc-furnace processes—for example, magnetic alloys and extra-low carbon stainless iron. In the manufacture of magnetic alloys, a carbon content of less than 0.04 per cent. is necessary, and this composition is readily obtained by melting the highest grade of Swedish wrought iron with the necessary nickel and other alloys in high-frequency furnaces. The remelting of low-carbon stainless alloys of the chromium and chromium-nickel series without any pick-up of carbon is a valuable use of the high-frequency furnace. The melting in an acid lining of rolling-mill scrap produced from steel made in basic-lined arc furnaces yields a steel with all the qualities of acid steel which are so valuable for gun and aeroplane and other steels requiring good transverse tests.

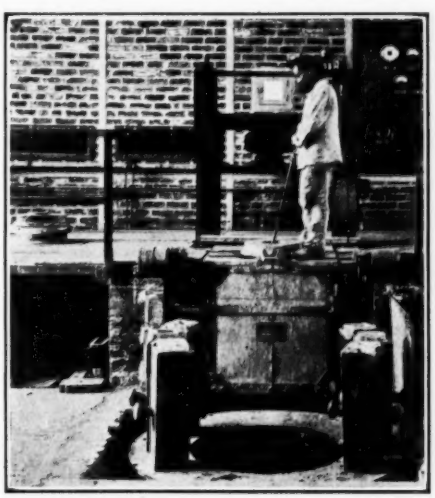

Fig. 3.—10-cwt. (400-kw.) High-Frequency Furnace installed at the Works of Messrs. Schneider et Cie, Le Creusot, France.

D

An important steelworks has recently been designed exclusively for the manufacture of alloy steels for automobiles and similar purposes. The equipment incorporates large Héroult furnaces for the refining of basic steel, and the rolling-mill scrap of known composition will be remelted in high-frequency furnaces without substantial alteration of composition and have all the advantages of a pure steel finished in an acid lining, the importance of which is a fruitful subject for discussion.

Heat-resisting steel, die steel and other complex and refractory chromium alloys can be melted in acid or basic linings without substantial alteration of composition.

The melting of nickel-chromium alloys for resistance wires, etc., in furnaces with basic linings permits the use of lime-fluorspar slags. The use of basic linings, made by the Rohn process, in the furnace is proving very satisfactory when melting high-nickel alloys which should be covered with a lime-fluorspar slag. Manganese scrap, especially for small castings, can be remelted without substantial loss of manganese, with magnesia or alumina linings.

In small furnaces of extra-high frequency (about 20,000 cycles), the melting of hard materials of the tungsten-chromium-cobalt-carbide group, which are being cast in form moulds, at a temperature of 2,000 to 2,300 deg.

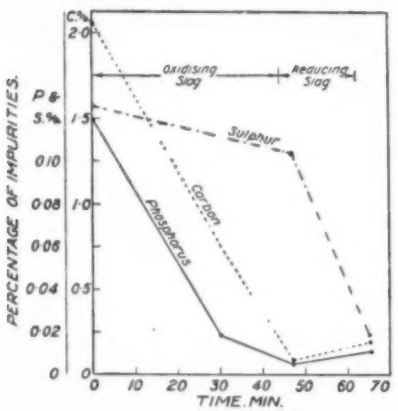

Fig. 4.—Removal of Carbon, Sulphur and Phosphorus in High-Frequency Furnace.

C., can be carried out. These materials, which are finding an increased application for dies and other uses, may be cast into moulds of the form required.

In addition to the established industrial uses, rapid progress is being made in determining the commercial value of the following metallurgical operations. The refining of steel is performed in basic-lined furnaces by slag reactions similar to those used in arc furnaces. The refining operation is extremely rapid, owing to the circulation of the metal due to electrical forces. Furthermore, this movement constantly brings hot metal in contact with the underside of the slag layer, thus keeping it hot and maintaining ideal refining conditions at the slag-metal contact surface.

Figs. 4 and 5 show the extraordinary rapidity with which carbon and phosphorus are removed under oxidising conditions. These may be obtained either by the use of iron oxide in the form of ore or mill scale or, alternatively, by an air blast. Sulphur may also be removed more slowly, and the usual slag reactions may be worked with great rapidity, owing to the speed with which fresh metal is constantly brought into contact with the refining slag.

Duplex processes—either with the open-hearth or with electric arc furnaces in countries where the latter is the cheaper melting unit, where steel must be finished in an acid lining and only basic steel is available—show considerable promise. For example, in certain Swedish works the following problem presents itself: It is proposed that a 1-ton high-frequency furnace should be installed. This furnace would be capable of making ingots large enough for 90 per cent. of the requirements of the shop. Occasionally, however, ingots up to 10 tons in weight would be wanted, and these would be of a specification requiring acid steel. It is accordingly suggested that a 1,000-kw. high-frequency equipment should be installed which would supply alternatively a 1-ton or a 10-ton furnace. The 1-ton furnace would be used for melting, and the 10-ton furnace for finishing steel previously melted in a basic open-hearth or basic electric-arc furnace.

The conversion of molten pig-iron into steel with the elimination of carbon, silicon, manganese, phosphorus and sulphur is carried out in basic-lined furnaces. The possibilities of converting liquid pig-iron into steel are extremely interesting on account of the great rapidity with which the reactions occur owing to the intense circulation. The excessive over-oxidation of the basic-Bessemer process is avoided, and by control of the circulation the conditions may be varied from those of a violently-oxidising furnace to the comparative tranquillity of an open-hearth or crucible furnace, which is desirable for finishing processes.

If a comparison be made between a steelworks equipped with six 75-ton open-hearth furnaces producing 6,000 tons a week, and ten 6-ton high-frequency units giving the same output and casting direct into ingot moulds, it will be found that the capital cost of the latter equipment will be considerably less, and the operating advantages would be numerous. Instead of 100-ton cranes and buildings of corresponding strength, the maximum lift in the melting shop would be limited to 10 tons, while a regular supply of ingots would be available at regular intervals, which would avoid the necessity of large and expensive soaking pits and ladles. The fact that steel may be charged within a few minutes of starting work on Monday morning, and the possibility of completely shutting down furnaces during week-ends, are important features which are also attractive in the case of the Bessemer process. The space occupied by six 75-ton open-hearth furnaces, and ten 6-ton high-frequency furnaces, with two metal mixers in each case, would be about 70,000 and 32,000 sq. ft. respectively.

The present state of development justifies the statement that such refining furnaces can now be made. Details of metallurgical practice doubtless require further experience, and the difficulty of sample-passing requires consideration, but the accuracy of heat control in electric furnaces and the absence of combustion gases should give such uniformity of product as to reduce the necessity for sample-passing. The possibility of such a steel-making plant producing a large output without the excessive capital expenditure, which has characterised recent works, is certainly worth profound consideration. Important improvements in equipment and process work have been accomplished in the last two years. The improvement in the efficiency of motor-generator sets is remarkable. For 150-kw. generator sets efficiencies of 73 to 75 per cent. were acceptable two years ago, but now 83 to 85 per cent. is obtainable for this size of machine. This improvement represents about 70 kw.-hr. per ton in normal practice, or about £200 per annum when using electricity at 0.6d. per kw.-hr. and melting 100 tons per month.

British motor-generator sets of 400 kw. output are now giving 84 to 85 per cent. efficiency, and 650-kw. sets an overall efficiency of 88 to 89 per cent., thus reducing the conversion losses to comparatively low figures. It is true that in the arc furnace the transformation losses are less, as static transformers are used, but the arc-furnace efficiency is very low as compared with that of the induction furnace. The efficiency of motor-generator sets is of the utmost importance, as units lost in transformation are wasted and cause objectionable heat.

Improvements in condensers have been rapid, aluminium sheet having generally replaced tin-foil, while water cooling by internal coils or by external cooling tanks has been generally adopted. The construction of the furnace bodies, which must be either of non-magnetic materials or protected by magnetic shields, has undergone considerable modification. The smaller furnaces are built of asbestos-cement boards, with a non-magnetic metal skeleton, and the larger ones may be built either in the same way or of steel plate with a suitable magnetic shield (see Fig. 1).

If any magnetic structure is near the inductor coil, it will heat and absorb energy unless a

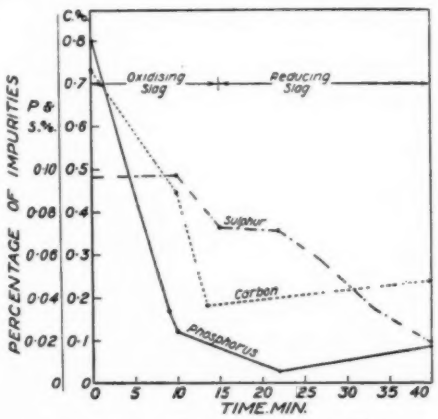

Fig. 5.—Steel-Refining in the High-Frequency Furnace.

shield is provided between the inductor coil and the steel casing. This consists of a number of silicon-steel laminated "legs," similar to those used in the construction of a transformer, so disposed as to make an easy path for the magnetic flux and shield the outer steel plate from the lines of force which produce eddy currents. This method of building furnaces with a magnetic shield is expensive, but permits of the construction of a simple and robust furnace such as is required in a steelworks, and of an improvement in the power factor. The alternative method of building with larger air spaces

(*Continued on page 201.*)

Table II.—*Results obtained in 10-Cwt. High-Frequency Furnace.*

Heat No.	Type of steel.	Time. Min.	Kw.-hr. per ton.
4	18 per cent. tungsten	63	640
5	" " "	65	650
6	Carbon	64	640
7	"	66	700
8	20 per cent. tungsten	54	576
9	" " " ..	54	588
10	" " " ..	53	553
11	Carbon	62	652
12	"	66	658
13	"	60	635
14	18 per cent. tungsten	59	610
15	20 per cent. " ..	65	600
16	" " " ..	60	634
17	Stainless	69	686
18	18 per cent. tungsten	57	608
19	18 per cent. Cr, 8 per cent. Ni	59	626
20	20 per cent. tungsten	85	670
21	" "	54	572
22	" "	61	590
23	" "	57	582
24	" "	53	578
25	" "	50	556
26	" "	54	572
27	" "	55	556
28	" "	54	548
29	" "	55	554
30	" "	53	579
31	" "	56	579

Average per charge: 60 min.; 605 kw.-hr. per ton.

German Iron-Foundry Owners' Federation.

ANNUAL MEETING AT EISENACH.

First Day.

On September 4 and 5 the 60th annual meeting of the German Iron-Foundry Owners' Federation was held at Eisenach, with Dr. S. G. Werner in the chair. Representatives of public bodies, technical institutions and allied associations presented their congratulations and good wishes on this important occasion. The first part of the meeting was, as usual, reserved for the sessions of the Federation's committees. In addition, various technico-scientific Papers dealing with foundry matters were read on the opening day. The first speaker was Dr. Ascher, of Frankfort-on-Main, who dealt with the subject "From Handicraft to Mass Production," the chief points being as follow:—

Co-operation of Medical Science and Industry.

The mechanisation of work by the substitution of machines for manual labour and the crowding of human beings in towns and centres of industry, in conjunction with the premature employment of children, gave rise to alarming symptoms in the nation's health. These had been counteracted by improved machinery and the enlistment of intellectual ability instead of muscular force, combined with a better standard of living. The unprecedented improvement in vital conditions, particularly as regarded the working period of human life (from the age of 15 to 60), could be demonstrated beyond all doubt, quite definitely in highly industrialised countries, such as England, Scotland and Prussia, not only by statistics, but also by scenes from the life of workers, as shown on the films, etc. The process of rationalisation fostered this development and, if due consideration were given to the physiological conditions of human life, might prove a great blessing. By further subdivision of the work, rationalisation rendered it easier for the worker, as only a restricted set of muscles then came into play. The danger involved in the continuous, one-sided and too rapid employment of individual parts of the body could be eliminated by suitable organisation of the work, without detriment to economic results. If industry and medical science co-operated, remunerative employment could be created also for elderly workers and for those suffering from some physical disability, so that the cost arising out of illness and of pensions in respect of disablement or accidents, which now absorbed a substantial and growing proportion of the profit, could be materially reduced.

Minimising Human Energy Waste.

Herr G. Stern, Chief Engineer, of Frankfort-on-Main, spoke on the subject of "Mass Production and Expenditure of Human Energy." His remarks were based on investigations concerned with the amount of energy expended by the worker on the introduction of the continuous-casting process. It was found, he said, that when this process was properly applied and the work rationalised, the curve of energy expenditure steadily fell. All unnecessary manipulations, all awkward movements, bad arrangement of the machines or of their actuating levers were eliminated. Internal transport journeys were reduced to the minimum; the individual operations themselves were investigated and the energy expended in moulding with the hand rammer, the hydraulic moulding machine and hand-lever moulding machine was measured, and the resultant data duly utilised. The investigations yielded valuable suggestions for the designer of moulding machines and for the arrangement of the actuating members of the machines. The scraping-off of the surplus sand was critically considered and investigated as to energy expenditure. It was shown that the shape of scraper which was found to be most advantageous permitted a reduction of 50 per cent. in the energy required. In this way the worker was protected from excessive fatigue and needless waste of energy.

Taking sand-shovelling as an example, the speaker described in detail how the test was conducted and how the measurement was facilitated by the introduction of an assistant. With the aid of a graph it was shown to what degree the worker's output might be enhanced, and that such increased efficiency is in no way proportionate to the energy expended, that is to say, notwithstanding a substantial increase in output, the expenditure of human energy is increased only by a quite small percentage.

Professor Paschke, Dr. Ing., of Clausthal, dealt with the "Production of a Special Pig-iron and its Use in Foundry Practice." He stated that after years of experimenting it was now possible to produce in the blast furnace, in addition to a high-alumina slag of excellent hydraulic properties, a special pig-iron eminently suitable for quality amelioration. In the last few years attempts had repeatedly been made—but with different aims—to run blast furnaces on high-alumina slag. A series of experiments made with an experimental furnace at the Rolandhütte in Weidenau were—in divergence from the American researches—directed first of all to producing a serviceable pig-iron with a slag which was destined for use as refractory cement, which cement was usually produced in the electric furnace. The large scale experiments begun in 1929 differed materially from the earlier tests, in that in this case the working conditions were absolutely normal; also the duration of the tests was long enough to eliminate snap results. The initial materials were Istrian and Hessian bauxite, limestone, high quality ore or scrap iron. The average composition of the pig-iron was the following:—C, 4.50 to 5.00; Si, 0.10 to 0.30 (according to how the furnace was run); P, 0.10 to 0.20; Mn, 0.50; S, 0.02, and Al, 0.015 to 0.02 per cent., which last was present in the metallic form. The desired composition of the slag specified at the outset, viz., SiO_2, 7.5 per cent.; Al_2O_3 + TiO_2, 45.0 per cent., and CaO, 40 per cent., was obtained without difficulty.

In further elucidation of the special importance of aluminium in this pig-iron, Prof. Paschke then described the reducing effect of manganese and silicon in the casting of steel ingots, while referring to A. L. Feild's researches, according to which this effect was attributable to decrease in the pressure of the carbon monoxide. Where the carbon monoxide pressure was sufficiently low, the separation of gas was no longer considerable. The action of Al as compared with Si being essentially greater in this respect, it was possible that the aluminium content in this special pig-iron reduced the carbon monoxide pressure sufficiently to prevent the separation of gas during the solidification period to any great extent. This would fully account for the absence of gas separation, to which cause was to be attributed the good properties of the charge blended with this pig-iron and of the cast iron produced therefrom. The results obtained in respect of the reducing action of silicon upon steel could not, however, be applied forthwith to cast iron, for it was precisely in high-silicon cast iron that the separation of gas during solidification proved to be an undesirable factor. This special pig-iron containing aluminium behaved as a gas-free alloy. The graphite would therefore be formed in low temperature zones, where the number of nuclei was already high, but the crystallisation speed low. The graphite was separated in the most advantageous form, *i.e.*, in numerous short flakes. Kish graphite, in the sense of hyper-eutectic graphite, was completely absent. There was practically no danger of the graphite remaining undissolved in the re-melting process in the cupola furnace and setting up germ action in the casting itself during solidification, for the small graphite flakes in this special pig-iron were completely dissolved at cupola furnace temperature. Owing to the low silicon content the percentage of combined carbon was invariably very high (about 0.9 per cent.). The matrix structure consisted of pure pearlite; free ferrite was almost entirely absent.

Tests in respect of the use of added pig-iron for grey cast iron were then described. Large scale tests were made in the cupola furnace with the object of establishing whether the quality of the casting was improved by additions of the special pig-iron. In this connection the mechanical properties of the casting were primarily investigated. Two cupola furnaces with respective melting capacities of 8 tons and 5 tons per hour were available for the tests. The results showed that the tensile strength figures ranged within the limits of the ordinary machinery castings. In respect of piping tendency and "life" the result was excellent. Notwithstanding the large addition of steel, no difficulties of a technical nature arose at all. Normal charges containing about 0.50 per cent. phosphorus, without any addition of special pig-iron, were first subjected to examination as to life. The result of this test showed that despite the high percentage of phosphorus in the alloys the mould did not fill, while the cast iron, with addition of special pig-iron, at the same casting temperatures and with a phosphorus content under 0.10 per cent., behaved excellently in respect of life. The castings invariably came out with perfectly sharp edges, even in the thinnest and most remote sections. In the piping test the effect of the special pig-iron was likewise distinctly marked. With an addition of as much as 10 per cent. the casting was entirely uniform; with a 5 per cent. addition, the expected cavities appeared.

As a high degree of tensile strength could also be obtained by other means, the peculiar merit of the pig-iron in question consisted in the production of sound castings, which property was apparently due to the fact that even very small amounts of metallic aluminium were sufficient to influence the melt advantageously, owing to the resultant reduction of the carbon monoxide pressure. The same applied in the matter of enhanced life.

Even though these results were not definitely conclusive, yet they indicated means of replacing imported special pig-iron by the German product in question. Several foundries had latterly been using this pig-iron as added pig-iron, instead of the Swedish charcoal pig and Indian pig, with continued success.

Rationalisation in Germany.

Finally, Dr. Geilenkirchen, Düsseldorf, spoke on "The Economic Organisation of the German Foundries."

He pointed out that the wave of rationalising enthusiasm which had swept through the German industry some years ago had now subsided. The expected success had not been achieved because the economies effected had either been swallowed up in the payment of interest on the loans which had been taken up—in part, abroad—for the purpose of carrying out this rationalisation, or been anticipated by the increases in wages that had previously been extorted. It was necessary that the idea as to establishing the most economic system of working in all branches of foundry work, as demonstrated to the industry by last year's Foundry Trade Exhibition at Düsseldorf, should strive for fullest recognition, as only by that means would it be possible for the foundries to keep their heads above water in these times of depressed prices.

XUM

Operations in respect of organisation and technical working were more difficult to appraise from uniform standpoints in the foundry than in any other branch of industry, because its economic structure, as conditioned by its evolution, was fundamentally different. There were blast-furnace foundries where only a very small proportion of the finished casting was produced directly from blast-furnace iron: either the liquid iron from the blast furnace was treated in a heated mixer, or they melted their cast iron in the cupola furnace from their own pig-iron and scrap independently of the blast furnace. The bulk of their output consisted of mass products, in which the material used played the more important part, *e.g.*, pressure pipes, drain pipes, castings for sewage purposes, radiators, ingot moulds for steelworks and rolls. On the other hand, there were foundries where bought raw material only was melted. These, as structural and commercial foundries, manufactured finished products directly or else machinery castings which were finished at their own or at outside engineering shops.

In accordance with this subdivision, the manufacturing methods of these foundries varied. The ruling principle for all such foundries was that they must as far as possible specialise in a particular type of cast product if they desired to reap the full benefit from their plants. In most cases the conditions for such specialisation and the organisation of continuous finishing had been established in the blast-furnace foundries, and partly also in the structural and commercial foundries, in so far as they were manufacturing mass products, *e.g.*, pressure pipes, drain pipes, etc., which were latterly being produced by the centrifugal process. The producers of the various cast products of the same kind were controlled by the Associations concerned, which regulated sales and prices. In the large detached foundries, on the other hand, a strong tendency to centralisation was apparent, which had led in some cases to the formation of combines, so that the possibilities of specialising had been further extended. The technical equipment in the commercial foundries varied greatly, according to their products, whether castings for sewage purposes, stoves, grates, radiators, baths, etc.; nevertheless they were better able than the other foundries to provide special equipment for the purpose of increasing their output capacity. In contradistinction to the detached foundries producing finished castings, the engineers' foundries only supplied raw materials for the engineering works. Their economic organisation was also different, according as they were or were not connected with an engineering works. Whereas in an iron foundry, working primarily for its own engineering shops, the relation between the two departments was naturally determined by the joint management, while technical and economic improvement in the one section could only be effected with advantage to the whole, provided that mutual understanding and consideration were shown, such friendly relationship did not, unfortunately, always exist between the engineering works, pure and simple, and the foundries which supplied them—greatly to the detriment of both parties.

A foundry which was combined with an engineering works afforded the guarantee that the assembler of the castings worked in close co-operation with the foundry manager. In this case, moreover, conditions were the more favourable in proportion as the engineering works had endeavoured to restrict its manufacturing programme to the quantity production of only a few types of the same kind of machine. The quantity production of the engineering works would then react favourably on the iron foundry, so that under certain conditions continuous conveyor plants were suitable also for the latter, or at least special moulding machines and devices could be employed.

In foundries belonging to engineering works where commercial castings were produced for other consumers, it was important to see that such castings fitted into the rest of the manufacturing programme. This applied particularly to detached foundries pure and simple, which, moreover, owing to their great dependence on the state of the market and their generally comprehensive working programme, were more affected by economic fluctuations than any other class of foundry, and so were most jeopardised by unfavourable crises. At such times they encountered the competition of engineering works, and even of the producers of malleable castings, whose products did not appear on the market at other times, but who now thought themselves obliged, by expansion of their sales and relinquishment of extra profits, to keep their works running at full capacity, while the commercial foundries proper, which were wholly dependent on their *clientèle*, had to restrict working owing to insufficient sales. The distressful position of the detached foundries was exploited by the buyers—regrettably, also by important public services, such as the State railways and the Post Office—in order still further to depress prices which even at normal times scarcely left a margin of profit. If the German Iron-Foundry Owners' Federation was endeavouring by teaching the proper method of cost calculation, as well as by amalgamations on a sort of combine basis, to protect its commercial foundries from the effects of these conditions, its object was not to increase the price of cast products to the detriment of public economy, but to save from ruin an entire branch of industry which was of vital importance to Germany's economic life.

At the same time it was, of course, necessary that precisely these detached foundries should specialise more than hitherto and so create the essential conditions for increasing their output and cheapening the cost of production; further, they must take advantage of all the modern achievements of technical science in respect to working and organisation so as to enable them to work more economically than hitherto, even without large capital expenditure.

Second Day.

On Friday, September 5, discussions on the markets took place in the forenoon. Separate sittings of the detached foundries and engineering foundries ended with a discussion on the raw-material markets: pig-iron, cast scrap, coal and coke.

Chairman's Address.

The general meeting proper, which at first was open to members only, took place in the afternoon, this time having been set apart for the discussion of various Federation matters. At the public proceedings the chairman, Dr. S. G. Werner, of Düsseldorf, reported on the activities of the Federation briefly as follow:—

The town of Eisenach had historical associations not only in relation to the political and cultural development of Germany, but also for the German Foundry Owners' Federation. In the 60 years' growth of the Federation the present occasion was the sixth on which the general meeting had been held at Eisenach. The economic, politico-economic and sociological problems, as also the technical problems, which had been dealt with at the five previous meetings, were the same as those which occupied their attention to-day. There had been ups and downs in the economic position of the foundries, and if at the 1885 meeting they had been particularly gratified at being able to establish that by the activity of the Federation the price of castings had been brought up to an advantageous level which ensured suitable profits to the foundries, at other meetings complaints of the contrary were raised. Never before, however, had the position of the entire German industry, including the iron foundries, been so cheerless as at the present time. In the year under review the wretched economic position had been brought home to all their members more or less keenly. The extent of employment had fallen from month to month, and many of the members had been forced to restrict working hours or even to close down entirely. The total number of employed foundry workers liable to the payment of contributions fell from 70,500 on April 1, 1929, to 62,000 on April 1, 1930, and by July 1 the number had fallen to 60,000. Of all the Federation's tasks, the members rightly regarded as the most important the establishment of a price policy which would enable the iron foundries to sell their products at adequate prices; to this task all the other work of the Federation had to be subordinated. This was being done, inasmuch as every measure which served to provide the raw material and working stock more efficiently and cheaply or to reduce production costs, or to improve the general vital conditions of the foundries, to reduce taxes, both national and local, as well as transport costs, or to open up new markets at home and abroad—all such measures placed the members in the position to withstand a pressure in prices, which owing to the force of circumstances could not be avoided, without being crushed themselves thereunder. As to the right way of establishing a sound price policy, opinions still differed. Whereas some of the iron foundries believed it was necessary even nowadays to give preference to the educational method, others held that in view of the existing economic difficulties the establishment of definite guiding principles in respect of prices would have more effect. The directorate held the view that both measures could only be carried out jointly. Now, as before, education in the proper calculation of production costs was no doubt an important task for the Federation, as experience daily showed that this matter was greatly neglected by a large number of firms. The furtherance of an unimpeachable system of calculating production costs was assisted not only by the guiding lines laid down by the Federation in the Harzburg leaflet, but also by the calculation price lists which had for some years past been prepared on those lines in respect of individual castings arranged according to weight classes and production difficulties. The decline in the price of foundry products which had occurred in the course of the last few months was to be attributed primarily to the disparity between supply and demand. There were practically no grounds on which the fall could be justified, even on a calculation basis. It was only the considerable decline in the price of scrap that enabled the foundries, by the saving effected in respect of the charge, and particularly also by using a larger proportion of scrap, to avoid or at least to diminish the losses which otherwise would have resulted from the heavy fall in the selling price of foundry products. The general economic problems, the importance of which on the prosperity of the foundries was unfortunately underrated even by a large proportion of the members, had been dealt with by the Federation in closest co-operation with the chief Associations, particularly the Reichsverband and the technical iron-producing section belonging thereto. The technical work of the past year, after the Düsseldorf Exhibition of the previous year, had been primarily concerned with the proper application of the experience gained thereat. In this connection they had endeavoured, by keeping in constant touch with the German Foundrymen's Technical Association and the other foundry associations with which they co-operated in the Chief Technical Committee, to avoid all overlapping. The conduct of the work was in the hands of one or other of the associations, according to arrangement. The properties of cast iron and modern methods of determining them, and the question as to the expansion of cast iron, had been dealt with by several committees. Investigations as to the manufacturing possibilities of cast iron were carried out at Aachen; the Committee for High Grade Cast Iron had been able to finish their work; a new committee had been formed for determining the characteristic properties of cast

iron. The work of the Foundrymen's Committee for the standardisation of test bars was so far advanced that it had been possible to publish a draft for the purpose of obtaining opinions thereon. The standardisation of pig had presented difficulties, but the work had recently been resumed with success. Tests to establish the properties of a serviceable foundry coke, or the applicability of the coke produced in modern large-chambered coke ovens to foundry purposes, had not yet yielded conclusive results. The work in connection with the investigation and exploitation of the natural sources of moulding sand in Germany was making progress. The problems in the art of melting had been investigated chiefly by the Giesserei-Beratungs G.m.b.H., founded by the Federation, which company had also directed the melting tests with foundry coke referred to above. As in previous years, the Federation's activities were concentrated on the problem of testing and rationalising the cupola-furnace plants. In dealing with the technical problems of moulding in foundry practice, the Federation could be satisfied with affording the foundry-engineering works the opportunity of displaying to the foundries their achievements in all directions. The Foundry Trade Exhibition of the previous year had shown that all the German foundry-engineering works had vied with one another in the endeavour to supply the best possible equipment for sand preparation, machine moulding and fettling, and to offer the most suitable apparatus for all requirements. As to the foundries themselves, especially the detached foundries, it was important that they should properly organise their work and, with the aid of the available equipment and the provision of new devices, strive to extract the maximum output from the men without overworking them. In this connection the extremely important directions which have been formulated with regard to determining the proper working hours and which had been supplemented during the past year, were of primary service. In co-operation with the Committee for Economic Adjustment a pattern chart had been prepared for the systematic control of the pattern storage. Special attention was given to the training of technical entrants to the industry. The work of the "Gina," the technical Standardisation Committee for Foundry Work, was being energetically pursued. The Federation considered that its chief task was to provide its members with the means of meeting successfully the struggle for existence.

The Siegfried-Werner Medal.

Herr Emil Vogel, Kommerzienrat, of Leipzig, was then presented with the Siegfried-Werner Medal in recognition of his services in the field of foundry practice on the technical and economic side. The deputy-chairman of the Federation, Dr. Walther Waldschmidt, Justizrat, Berlin, who had recently celebrated his 70th birthday, was made an honorary member of the Federation in recognition of his great services. Herr Meinel, Oberbergdirektor, Munich, who could look back upon a 25 years' membership of the Advisory Council to the Federation, was presented with a fine-art casting as a complimentary gift.

Germany's Economic Troubles.

Finally, Professor Leidig, a member of the Prussian Diet, spoke on "The Economic Year 1929/30."

After having reviewed the development of Germany's financial and economic policy since the end of the war, the speaker referred to the result of this development as disastrous, both financially and economically. At the close of 1929 and again at the end of March, 1930, the treasury was empty and the Reich had to depend on the help of the banks, which was granted under crushing conditions, for meeting the most urgent expenditure. Since the autumn of 1929 unemployment had increased so rapidly and to such an unlooked-for extent that the unemployed insurance fund would have been bankrupt had not the Reich continued to pour out fresh subsidies, which also were swallowed up. Such subsidies prevented the re-establishment of the national finances on a sound basis.

It was, therefore, obvious to everyone that only a complete *volte-face* could alleviate the crisis. The call for economy in public expenditure was accordingly re-echoed on all sides. The argument as to the expenditure being imperative and unavoidable no longer deceived anyone, and so the first tentative step had at least been taken in the direction of restricting public expenditure. A saving of 135 million marks in a budget of 10 milliards, *i.e.*, less than 2 per cent., was intended to be effected this year. Over and above this, it was necessary to demand that the enormously swollen ranks of the bureaucracy and their excessively extended powers should be reduced to the pre-war limits. In the face of such a disaster as that which the unemployment of upwards of 2½ million people had brought upon Germany, both the State and the community must, of course, make sacrifices in exactly the same way as in the event of a natural catastrophe. Remedial measures could, however, only be presented in the sense of making sacrifices and not, as was now happening, on technical insurance principles in favour of those claiming unemployment benefit. Only then would it be possible so to restrict the national subsidy that it should not constantly threaten to upset the entire budget.

The German industry was involved in the present grave crisis, partly owing to the heavy slump on the world's markets. The revolutionary fall in the prices of the raw materials reacted partly in favour of Germany, where it was a matter of foreign raw materials to be worked up by the German industries. On the other hand, the heavy slump in prices by which the countries outside Europe which supplied the raw materials had been particularly hit, had considerably reduced the purchasing power of the population of those countries, so that they were naturally less prepared to take goods imported from Germany. Thus the world-wide depression reacted on the German industry. In Germany itself the price level of nearly all industrial products was heavily increased as compared with foreign countries. The German wages policy since the war was obviously not alone to blame for this increase; in numerous branches of industry, where the wage item constituted a substantial part of the production costs, wages had to be reduced in order to effect a reduction in prices. The reduction of the public burdens was the second prerequisite for reducing prices. If in 1913 the total burden of taxation amounted approximately to RM 8 milliard, and in 1929 to upwards of RM 26 milliard, a comparison of these figures, even taking into account the rise in the cost-of-living index, showed how enormously the burden had increased since the war Even if a part of this increased burden was unavoidable, owing to the expenditure entailed by losing the war, nevertheless, there remained a much larger proportion of the expenditure, which was due to a mistaken adjustment of the post-war policy with the object of raising the standard of living in Germany, as if by such means the consequences of losing the war could be wiped out. If inflation, too, was largely to blame for this mistaken policy, the time had definitely arrived to demand reform, now that the results had been made clear. Its effect was so to paralyse our industry that it could no longer compete abroad, while the excessively high prices, which exceeded the purchasing power of the population, killed the home market. In addition to these general difficulties, there was the particular difficulty created by the distress in German agriculture, especially in the east, owing to which the industry was deprived of one of its most important customers. An indispensable function of the State policy was to create the necessary conditions to enable agriculture to be profitably pursued. This could not be achieved without great sacrifices on the part of Reich and State.

Although the review of the present position of German industry was exceedingly gloomy, there was no need to lose hope. The rationalisation of the German industry had, perhaps, been too vehement, too hasty. It was, however, entering the new upward movement well equipped with modern aids. The low rate of interest at present obtaining throughout the world was spreading from the money market to the capital market, so that here, too, better conditions for the industry were present than hitherto. If it could be allowed a larger measure of elasticity by relaxing of the rigid wage tariffs, it might be hoped that the conditions for the recovery of the German industry were present.

The speaker concluded with an avowal of trust in the future of the German industry and of the German people.

High-Frequency Steel Furnaces.

(*Continued from page* 198.)

round the inductor coil, on a frame of non-magnetic metal with asbestos-cement composition boards, gives a furnace that is quite serviceable and less costly.

The method of operating these furnaces is extremely simple; the method of charging involves the minimum of labour, and repairs to refractories are a small item owing to the small quantity used. The charging door consists of a hole in the working platform, and a 1-ton furnace can be charged in 1 to 2 mins., if a reasonable quality of scrap is available. Two pans, each containing 10 cwts., may be conveniently prepared and laid on the platform by the crane. These are tipped up by the crane and shot into the furnace, or raked down out of the sloping box by the furnace man. One man is sufficient to charge and cast 1 ton of metal every 60 to 75 mins., provided the raw material is delivered on to the platform and the ingot moulds are prepared and stripped by pit men.

There are no electrodes, a constant cause of expense and worry for the furnace man, and the repairs to refractories between heats are almost negligible. It is customary to break off any accretions in the slag line, and sand the bottom if there is any excessive wear. Induction furnaces do not wear excessively at the slag line or bottom, but fairly evenly.

The following figures indicate the relative weights of the refractories in furnaces of the same daily output:—Output (20 tons per day): High-frequency, 20-cwt., 4 cwts. of refractory; arc furnace, 4-ton, 260 cwts. of refractory; open-hearth, 8-ton, 2,000 cwts. of refractory.

The above figures indicate the great advantage of high-frequency furnaces for intermittent work, as the heating of refractories is a useless and expensive operation. The small weight of brickwork to be heated as compared with other furnaces results in low power consumption for intermittent work, and the possibility of pouring a heat of steel within 80 mins. of starting with a cold furnace.

The figures in Table II show results obtained when melting alloy steels of the composition indicated in 10-cwt. and 20- to 25-cwt. furnaces respectively. The former furnace is illustrated in Fig. 3.

The higher power consumption of the larger furnaces is not always due to a difference of efficiency in the melting equipment, as steel-making practice varies very much in different works. There is a great variety of opinion about the importance of this time factor in steel-making.

A New Silicon-Zinc-Copper Alloy.*

By Dr. E. Vaders.†

Introduction.

The use of silicon in the preparation of copper alloys has been known for only a few years, but its use as a deoxidiser for a much longer time. As such, silicon has the advantage over phosphorus that an excess has not nearly so deleterious an effect on the alloy as the same excess of phosphorus. It has also been recognised that small quantities of silicon increase the tensile strength of copper appreciably, so that the resulting alloy is more suitable than pure copper for the manufacture of conductor wires, and its conductivity is not very seriously diminished; 0.02 to 0.5 per cent. of silicon reduces the conductivity of copper only to 98 per cent.

Except as a means of introducing silicon into alloys pure silicon-copper alloys have, up to the present, found no technological use. Nor have similar alloys with additions of iron and manganese or nickel, cobalt, chromium, tungsten, or molybdenum been used to any extent, although such alloys were prepared in Germany in 1921 in the Institut für Metallhüttenwesen und Metallurgie at Aachen.[1] Borchers, under whose direction this work was carried out, hoped to be able to use silicon-copper alloys as substitutes for tin-bronzes. With the same object in view other workers have prepared numerous special alloys, most of which suffered from the disadvantage of being unworkable hot or of being worked only with difficulty with cutting tools.

Corson[2] discovered the age-hardening possibilities of silicon-nickel-copper alloys and other combinations with silicon and copper. But the age-hardened silicon-copper alloys do not satisfy all requirements—for example, their elasticity is, in no case, as great as that of the ordinary hard-rolled phosphor-bronzes. Again, the preparation of these alloys in uniform quality presents great difficulty, as the quenching and ageing temperatures must be kept within very narrow limits in order to avoid large deviations in the values of the mechanical properties.

Besides its use in the preparation of new alloys, especially those of copper and aluminium in which silicon forms an important part of the alloy, the element has been added in small quantities to many old and well-known alloys—*e.g.*, "aluminium-bronzes," copper-tin alloys and copper-zinc alloys. As the last named are of the most interest among copper alloys, the influence of silicon on them has naturally been more thoroughly investigated. Guillet[3] concluded, as the result of his researches, that the maximum permissible silicon content of copper-zinc alloys was dependent on the zinc content of the alloy, the greater the zinc content the smaller was the amount of silicon that could be added before the separation of a new constituent rendered the alloy too brittle. Table I shows the silicon content which, according to Guillet, first causes this new constituent to separate from certain copper-zinc alloys.

As will be seen, the new constituent appears in the 63.61 per cent. copper alloy with 2.55 per cent. of silicon, and in the 57.9 per cent. copper alloy with 1.96 per cent. of silicon. Guillet's work was almost entirely confined to a study of the effect of silicon on the ordinary brasses—*i.e.*, on those containing 57 to 70 per cent. of copper, and no systematic work was done on the behaviour of silicon in zinc-copper alloys with a higher copper content than 70 per cent.; he simply stated that about 2 per cent. of silicon entered into solid solution in the 90 per cent. copper alloy. This assumption of Guillet, and his statement that only small quantities of silicon could advantageously be added to brass, had the effect of deterring other workers from further investigating the ternary system silicon-zinc-copper. The results of the present work, however, show that silicon-zinc-copper alloys with a higher content of silicon than those prepared by Guillet are technologically useful, provided

Table I.

No.	Composition. Per cent. Cu	Si	Structure.
1	69.15	0.35	α.
2	68.84	0.81	α.
3	68.26	1.41	Traces of a new constituent.
4	64.03	0.96	Resembling brass with 59 per cent. copper.
5	64.30	1.77	New constituent.
6	63.61	2.55	" "
7	65.62	4.15	Resembling brass with 58.5 per cent. copper.
8	59.99	0.20	" " " "
9	59.83	0.30	" " " "
10	59.69	0.81	" " " "
11	59.41	1.37	" " " "
12	59.12	2.50	" " " "
13	60.05	4.51	New constituent.
14	57.56	0.35	Resembling brass with 56.5 per cent. copper.
15	57.81	0.86	Resembling brass with 50 to 54 per cent. copper.
16	57.09	1.96	New constituent.

that the copper content is sufficiently high. Whilst Guillet stated that zinc-copper alloys with more than 2 per cent. silicon were too brittle for use, it will be seen from what follows that quite valuable alloys can be prepared containing more than 2 per cent. silicon when the copper content exceeds 70 per cent. The mechanical properties and the technical uses of these alloys form the principal objects of the present Paper, but first details will be given of the methods used in establishing the boundary of the region of solid solubility of silicon in α-zinc-copper alloys.

The Solid Solubility of Silicon in α Brass.

The materials used in the preparation of the alloys were electrolytic copper, pure zinc, and silicon containing 1 to 2 per cent. iron. As the silicon content of the alloys studied did not exceed 6 per cent. in any case, the iron introduced by the impure silicon did not exceed 0.06 to 0.12 per cent.—a quantity which is permissible as an impurity. The alloys were melted in carbon crucibles in a high-frequency induction furnace, and for the preparation of less than 2 kg. of alloy it was found unnecessary to use a silicon-copper "hardening alloy." The copper and silicon, the latter in small pieces, were placed in alternate layers in the crucible, the mixture covered with a layer of wood charcoal to prevent oxidation and melted in the usual way, and finally the zinc was added to the molten alloy at 1,000 to 1,100 deg. C. The alloys were cast, for the tensile tests, in sand moulds to obtain rods 16 mm. in dia. and 20 cm. long. Table II shows the results of the tensile tests. The elongation is calculated on a length equal to 11.3 times the diameter. Hardness measurements were made with a 10-mm. ball under a load of 1,000 kg. applied for 30 sec. These remarks apply also to the figures in succeeding tables. Copper and silicon only were determined by analysis; zinc was taken by difference.

Small pieces were cut from these tensile specimens and used for the determination of the equilibrium diagram. They were annealed for 8 hrs. at 750 deg. C. in an electric muffle with temperature regulator and allowed to cool slowly in the furnace. After cutting and polishing, the sections were etched with a 10 per cent. solution of ammonium persulphate and photomicrographs made, from an examination of which the position of the boundary line (*ab* in Fig. 1) for the solubility of silicon in α brass was deduced. Perhaps it would be more correct to call the line *ab* the boundary of the solid solution range at the copper corner of the ternary system silicon-zinc-copper.

Melting Point.

The melting points of a few of the alloys with more than 86 per cent. copper and consisting of homogeneous α solid solution are recorded in Table III:—

Table III.—*Melting Point of Si-Zn-Cu Alloys.*

Composition. Per cent. (not analysed.) Cu	Si	Zn	Solidification commences at deg. C.
95	5	—	995
84	4	12	920
86	4	10	950
87	3	10	980
88	4	8	970
90	2	8	1,031
90	—	10	1,045

It will be seen that the melting point has a tendency to fall whether zinc or silicon is added, the lowest melting point occurring with the alloy having the highest silicon and the highest zinc content. Increase of silicon lowers the melting point to a greater extent than a corresponding increase in the zinc content.

Table II.—*Tensile Properties of Sand-Cast Silicon-Zinc-Copper Alloys.*

No.	Composition by analysis (per cent.). Cu	Si	Zn	Tensile strength. Tons per sq. in.	Elongation on 11.3 × dia. Per cent.	Brinell hardness. 10/1,000/30.
1	90.77	5.93	3.5	14.9	(?)	115.0
2	94.80	5.00	—	20.0	10.5	77.1
3	82.70	4.89	12.0	32.3	10.0	155.0
4	80.13	4.54	15.0	31.6	9.45	142.0
5	76.87	4.06	19.0	28.4	6.1	140.0
6	87.72	3.50	8.5	22.2	4.0	92.1
7	74.29	3.09	22.5	23.4	5.05	117.5
8	71.76	2.96	25.0	23.3	2.2	135.0
9	86.47	1.92	11.5	16.5	28.3	80.0
10	71.15	1.87	27.0	22.6	14.6	104.0

Specific Gravity.

Table IV records the density of some of the alloys. From these figures it will be noticed that alloys with the highest silicon content, the zinc content being constant, have the lowest specific gravity. It may be assumed that there is a simple relation between the specific gravity of ternary solid solutions and the specific gravity of the constituents such as holds good for binary alloys. The calculated specific gravities, however, show slight deviations, probably due to errors in the analysis; also the alloys contained 0.1 to 0.3 per cent. iron. The test-pieces on which determinations of the specific gravity were made were cut from rods cast in chill moulds.

* Extracted from a Paper read before the Autumn Meeting of the Institute of Metals.

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1 Abhandl. Inst. Metallhüttenw. Tech. Hochsch., Aachen, 1921, 1, (3).

2 "Iron Age," 1927, 119, 353.

3 "Rev. Mét.," 1909, 6, 252.

Cast Alloys.

The figures already given in Table II for sand-cast alloys show that silicon-zinc-copper alloys have a high tensile strength and a reasonable ductility. The values shown for alloy 3 in Table II are particularly noteworthy, when it is remembered that the usual tin-copper alloys used for casting purposes rarely have a tensile strength exceeding 15.9 tons per sq. in.

TABLE IV.—*S.G. of Si-Zn-Cu Alloys.*

Composition (by analysis). Per cent.			Density. Grm./c.c.
Cu	Si	Zn	
75.16	3.72	Remainder	7.85
81.28	2.78	,,	8.05
67.16	1.71	,,	7.98
81.92	3.01	,,	8.01
78.03	2.11	,,	8.13
90.0	Nil	10	8.66

The difference in the elongations of alloys 6 and 7 is remarkable; an increase of 3 per cent. in the zinc content has reduced the elongation from 11 to 2 per cent. This behaviour is explained by referring to the position of these alloys with reference to the line *ab* in Fig. 1; alloy 7 is just on this line, and alloy 6 well to the right of it.

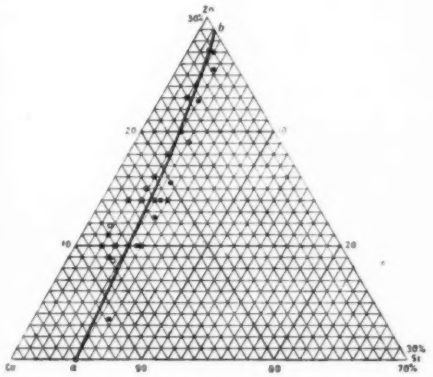


FIG. 1.—TERNARY SYSTEM SILICON-ZINC-COPPER, SHOWING THE SOLUBILITY CURVE OF SILICON.

From the results given in Tables V and VI it is seen that these alloys possess tensile properties which should make them technically valuable. Especially useful both for sand- and chill-castings should be the alloys with 70 to 90 per cent. copper, some of which in the cast state have a tensile strength exceeding 35 tons per sq. in., and others have an elongation of 40 to 50 per cent.; such alloys

TABLE V.—*Sand-Cast Specimens of Silicon-Zinc-Copper Alloys having a Cross-Section* 10 × 6 *mm.*

No.	Composition. Per cent. (not analysed).			Tensile strength. Tons. per sq. in.	Elongation. Per cent.	Brinell hardness. 10/1,000/30
	Cu	Si	Zn			
1	90	—	10	11.4	19	43
2	89	5	6	22.2	10	109
3	85	5	10	32.0	10	130
4	81	5	14	34.3	10	156
5	88	3	9	22.2	40	100
6	68	2	30	27.0	2	132
7	71	2	27	20.3	11	115
8	75	2	23	21.0	28	78
9	87	2	11	16.8	28	60

can readily be rolled and drawn whereby their properties attain values far superior to those of any of the usual zinc-copper alloys.

The figures in Table VI show clearly the effect on the mechanical properties of the alloys of the separation of the new silicon-rich constituent. When the boundary line of solubility is overstepped a discontinuity occurs in the dependence of the values of tensile strength, elongation, and hardness on the silicon content. Fig. 5 shows the results of Table VI graphically; curves *a*, *b* and *c* are for alloys with 14 per cent. zinc, and *a'*, *b'*, *c'* for alloys with 30 per cent. zinc. In the first case a sudden rise in hardness and tensile strength and a decrease in ductility occur between 3 and 4 per cent. silicon, and in the

TABLE VI.—*Chill-Cast Specimens of Silicon-Zinc-Copper Alloys having a Cross-Section* 10 × 6 *mm.*

No.	Composition. Per cent. (not analysed).			Tensile strength. Tons per sq. in.	Elongation. Per cent.	Brinell hardness. 10/1,000/30
	Cu	Si	Zn			
1	84	2	14	18.5	50.8	64
2	83	3	14	22.0	40.3	70
3	82	4	14	27.6	14.6	114
4	81	5	14	36.8	11.6	162
5	69	1	30	17.7	14.7	75
6	68	2	30	27.1	2.0	132
7	68	3	30	31.0	0.5	221

second case the increase in tensile strength and the decrease in ductility are more marked between 0 and 1 per cent. silicon than between 2 and 3 per cent. silicon; this is what would be expected by referring to the course of the line *ab* in Fig. 1. With the separation of the new constituent the ductility of alloys with more than 70 per cent. copper rapidly diminishes, but the hardness and strength increase.

Silicon-Zinc-Copper Alloys with Additions of Tin and Nickel.

Table VII shows that tin reduces the elongation and, to a small extent, the tensile strength of silicon-zinc-copper alloys. Addition of nickel also deleteriously affects the tensile properties; thus the elongation of alloy 2 (Table VI) is reduced from 40.3 to 2.1 per cent. by the addition of 2 per cent. nickel. The hardness is, however, slightly increased, but the tensile strength diminished by the nickel. These results are interesting, as nickel usually improves the properties of zinc-copper alloys. The reduction in the strength and ductility of silicon-zinc-copper alloys by nickel is to be attributed to the formation of nickel silicide.

Silicon-Zinc-Copper Alloys as Bearing Metals.

Whilst silicon-zinc-copper alloys decrease in strength and ductility by the addition of tin, due to the separation of a new hard constituent, their value as bearing alloys is thereby increased. Experiments have shown that silicon-zinc-copper

TABLE VII.—*Silicon-Zinc-Copper Alloys with Tin and Nickel. Chill-Cast Bars having a Cross-Section* 10 × 6 *mm.*

No.	Cu. Per cent.	Si. Per cent.	Zn. Per cent.	Sn. Per cent.	Ni. Per cent.	Tensile strength. Tons per sq. in.	Elongation. Per cent.	Brinell hardness. 10/1,000/30.
1	83.0	2	14	1.0	—	21.9	23.3	85
2	82.0	2	14	2.0	—	16.6	7.1	108
3	81.5	4	14	0.5	—	28.4	14.2	123
4	81.0	4	14	1.0	—	28.4	7.5	129
5	80.0	4	14	2.0	—	27.3	4.0	133
6	81.0	3	14	—	2	20.9	2.1	146

alloys, especially those with a small tin content, are valuable bearing metals. Preliminary tests of some of the silicon-zinc-copper alloys containing a little tin have shown that they will withstand a specifically higher load as bearing metals than ordinary bronzes.

The Preparation of Silicon-Zinc-Copper Alloys and their Casting Properties.

Although it was unnecessary to use a silicon-rich alloy in the preparation of the 2-kg. melts used for casting the test-pieces, it is essential to do so with melts of about 300 kg., otherwise the silicon floats on the surface of the bath and dissolves only slowly as it becomes coated with a zinc oxide layer which acts as an insulating sheath when the bath contains zinc derived from the addition of scrap. Hence it is advisable to prepare a 10 or 20 per cent. silicon-copper alloy first; this is so brittle that it can readily be broken up to be added to the charge in small pieces. The bulk of the alloy is prepared by adding a part of the silicon-copper alloy to a part of the copper previously melted, then adding the rest of the copper and silicon-copper alloy in small portions as it melts into the mass. After thorough stirring, the zinc is added, preferably also in the form of a high zinc-copper alloy, at a temperature not much exceeding 1,000 deg. C. For chill-castings the metal is cast at 950 to 1,000 deg. C., but for thin-walled castings, especially if made in green-sand moulds, a higher casting temperature is desirable.

(1) *Casting in Sand Moulds.*—The oldest known copper alloys for sand-castings are the

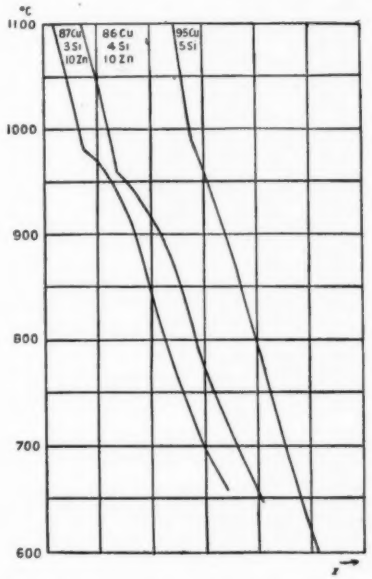


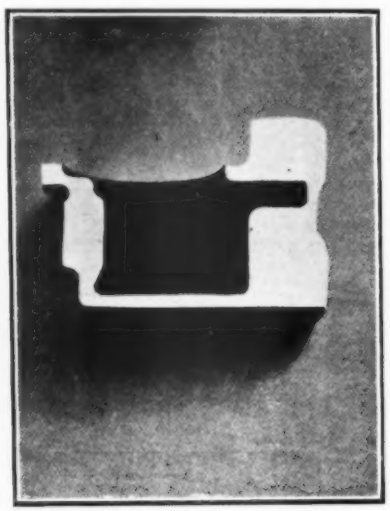
FIG. 2.—COOLING CURVES OF SILICON-ZINC-COPPER ALLOYS.

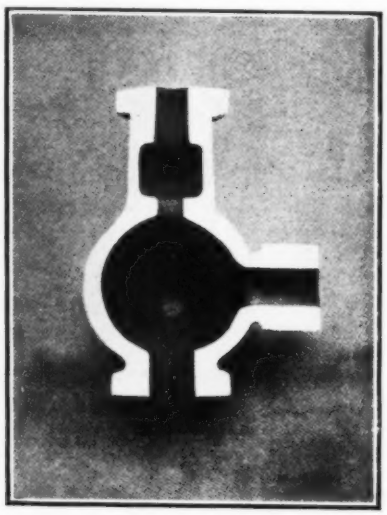
tin-copper alloys, which for a long time could not be displaced by any other material, as their fluidity far exceeded that of any other copper alloy. With the advance of technique and the increasing demand for better alloys, it was found that, in many cases, copper-tin alloys were unsatisfactory, and other casting alloys having a higher tensile strength than copper-tin alloys were developed; such were, for example, aluminium-bronzes and special brasses containing other elements in addition to copper and zinc. Although these had a higher tensile strength than the ordinary bronzes, much difficulty was experienced in making good castings owing to the inclusion of aluminium oxide, etc. These inclusions reduced the tensile strength appreciably, so that the mechanical properties of castings of aluminium-bronze rarely reached the values obtained on a carefully-prepared tensile test-piece. Moreover, aluminium-bronzes also undergo a relatively large contraction on solidification. Silicon-zinc-copper alloys can not only be readily poured, but they possess all the desirable tensile properties of aluminium-bronzes. From Figs. 3 and 4 it will be seen that there is not the slightest trace of porosity in the castings. Fig. 3 shows that even with considerable differences in the cross-sectional area the castings are free from internal pipes, and are of a uniform density throughout. The fluidity of the alloys is so great that even thin-walled sections, 2 mm. thick or less, can be poured without difficulty. An important feature is that the tensile strength is to a large extent independent of the

thickness of the test-piece; the result is obtained whether the test-piece is cut out of the casting or cast separately. Table VIII shows the tensile properties of some specimens cast from a large melt; it will be noticed that the difference in the values for green-sand and dry-sand castings is not great.

(2) *Chill-Cast Alloys.*—Permanent-mould castings have, up to the present, almost invariably been made from "aluminium-bronze," and little is known of the use of copper alloys with a high copper content for this purpose. In a recent review[4] the advantages and disadvantages of various copper alloys for chill castings are discussed. Brasses with a high zinc content present difficulties owing to the formation of zinc oxide which, with continuous working, soon contaminates the mould. "Aluminium-bronzes" which have been recently used for chill-cast parts suffer from the disadvantage of being readily oxidised, so that surfaces contaminated with aluminium oxide are produced. Aluminium-brasses, on the whole, behave well, as the presence of aluminium imparts an especially smooth surface to the castings. Besides the question of surface appearance, however, the tendency of an alloy to piping and the contraction on solidification must be taken into account, as well as the fluidity of the molten alloy. Alloys which have poor fluidity must be heated to a higher temperature when making thin-walled castings, and this increases the contraction on cooling. Silicon-zinc-copper alloys, however, are particularly suitable for chill-casting, owing to their extraordinarily great fluidity and the very clean surfaces of the castings due to the cleanliness of the surface of the molten metal. The contraction on cooling is such that the casting scale can be readily removed—an operation which is very troublesome with other copper alloys. The most suitable alloy for chill-casting is that containing 81 to 82 per cent. copper, 4 to 5 per cent. silicon and 14 per cent. zinc.

(3) *Pressure-Cast Alloys.*—The above remarks as to the suitability of silicon-zinc-copper alloys for chill-castings apply equally well to their use in pressure castings, more especially is the fluidity of the alloys of great value in producing smooth surfaces on the castings. Generally, copper alloys are not used for making pressure castings, but recently attempts have been made so to use brasses with 55 to 65 per cent. copper. These alloys do not give castings with smooth surfaces, and frequently they are porous. Pressure castings of the silicon alloys with, *e.g.*, 81.5 per cent. copper, 4.5 per cent. silicon and 14 per cent. zinc are not only denser, but have smoother surfaces than those of brass; they can be polished and plated in any of the usual baths, and thus form a valuable constructional material. Their strength is greater than that of similar brass castings, and in absolutely non-porous pieces may reach 45 to 50 kg./mm². with a Brinell hardness of 140 to 160, compared with that of 90 for ordinary brass.





Figs. 3 and 4.—Sections through Sand Castings of Alloy containing 81 per cent. Cu, 5 per cent. Si and 14 per cent. Zn.

Table VIII.—*Sand Castings, 15 mm. in Diameter, from Large Melts (100 to 200 kg.) Cast Separately.*

No.	Composition. Per cent. (by analysis).			Tensile strength. Tons per sq. in.	Elongation. Per cent.	Brinell hardness. 10/1,000/30.	Mould.
	Cu	Si	Zn				
1	85.25	4.75	10	30.9	12	138	Green sand
				29.8	11	128	Dry sand
2	81.5	4.5	14	29.2	9	125	Dry sand
				29.9	10	136	Green sand

[4] J. Inst. Metals, 1928, 40, 187.

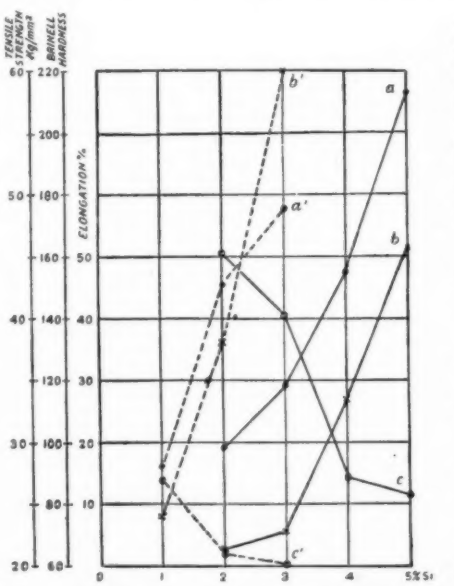


Fig. 5.—Curves showing the Dependence of the Tensile Strength Elongation and Hardness on the Silicon Content.

Machinability of Silicon-Zinc-Copper Alloys.

These alloys differ little in their working properties from the ordinary zinc-copper alloys, and can be turned, drilled and cut without difficulty. All are easily soldered, but joints should preferably be made by welding, as the presence of silicon reduces the tendency of the metal to oxidise. In the form of wires, alloys with 2 to 3 per cent. silicon make useful welding rods.

The Manufacture of Bells from Silicon-Zinc-Copper Alloys.

It is not by accident that copper-tin alloys have been used since ancient times for the manufacture of bells, although cheaper alloys were known. No alloy yet discovered has sonority equal to or better than that of copper-tin alloys, although quite a number of alloys, when cast into suitable shape, produce bells having an endurable tone. These bells are, however, usually more expensive than those made from tin-bronzes, so that the bellfounder has no incentive to make them. Tests made in Germany with bells made of aluminium-copper alloys showed them to be unsatisfactory, as, compared with bells made of bell metal, they had a much higher tone. The tone range also was not so good as with the ordinary bronze, the overtones being sometimes too high and sometimes too low, and the tone volume was not so great. Similar objections apply to steel bells.

Bells made of silicon-copper alloys, especially those containing 81 to 82 per cent. copper, 4 to 5 per cent. silicon, 14 per cent. zinc and about 0.5 per cent. tin, have, however, the same tone characteristics as bells of the same size made of tin-bronze. All subsidiary tones, such as the upper and lower octave, the third and the fifth, which are of such great value in determining the melodious character of the bell, are correct, but the bells have a somewhat mellower tone than that of bronze bells. This is the more interesting as the specific gravity of the new alloys is about 10 per cent. less than that of bell bronzes.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

1,979. Marks, Baron (Lucifer Products Company). Processes for purifying steel. 332,890.

2,967. Andrews, W., and Imperial Chemical Industries, Limited. Welding of copper. 332,894.

11,422. Holman Bros., Limited (Johannesburg Consolidated Investment Company, Limited). Drill steels. 332,914.

13,158. Triggs, W. W. (Norton Company). Production of aluminium oxide. 332,902.

14,178. Barnitzke, Dr. J. E. Flotation process for oxide-ores. 311,239.

20,817. Measures, J. F., and Russell, P. A. Machine or apparatus for making up runner bushes employed in casting metals. 333,024.

25,395. Heusler, Dr. F. Process of making cast iron and steel containing copper. 317,734.

25,644. Babcock & Wilcox, Limited (Babcock & Wilcox Company). Return bends for metal pipes. 333,064.

28,614. Lang, T. Rotary-tube furnaces. 319,335.

29,664. Brown, F. D., Richards, G. B., and Roberts, T. J. Water-cooled blowing-tuyères for blast furnaces. 333,095.

33,300. Yarrow, H. E., and Gresley, H. N. Preheating of the air supply to locomotive water-tube boiler furnaces. 333,113.

37,675. Associated Electrical Industries, Limited. Electric locomotives. 333,132.

For tapping aluminium, use beeswax or tallow as a lubricant.

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Trade Talk.

The Canadian production of steel castings for the first six months of the current year amounted to 37,881 tons.

Notices have been posted at the Briton Ferry Steelworks, Briton Ferry, stating that the works will be closed indefinitely at the end of the present month. Three hundred men are affected.

At an extraordinary general meeting of the Harwich Foundries, Limited, held at the Guildhall, Harwich, a special resolution that the company be wound up voluntarily was passed.

Owing to lack of orders, nearly 1,500 men have been discharged by Messrs. Cammell Laird & Company, Limited, at Birkenhead during the past few weeks, and it is possible that the South Yard will have to be closed shortly.

Messrs. Cowlishaw, Walker & Company (C.-W. Engineering Company, Limited, proprietors) announce that as from September 15 their address will be the Railway Engineering Works, Biddulph, Stoke-on-Trent.

The partnership between Messrs. John Ashton, John Herbert Ashton and Tom Plumtree, trading under the style of Ashton, Son & Plumtree, as ironfounders and engineers, at Dodgson Street, Rochdale, has been dissolved by mutual consent.

Messrs. Barimar, Limited, welding engineers, of 14-18, Lamb's Conduit Street, London, W.C.1, have successfully restored three badly-cracked bells of the Southfleet Church, Kent. One of these bells is over 300 years old, the other two about 200 years.

A cable received by the London Executive Committee of the British Empire Trade Exhibition, Buenos Aires, to be held next year, from Sir Herbert Gibson, chairman of the British Chamber of Commerce in Argentina, states that the new Government will give its full measure of support.

Messrs. Stewarts & Lloyds, Limited, have invited the Walsall Town Council to assist in administering a fund of £5,000 established by the firm to assist workmen over 60 who may suffer hardship through their purchasing the local tube works and closing it down under a scheme of rationalisation.

The Secretary of the Ministry of Labour announces that the Government have decided that the Unemployment Grants Committee may recommend a special grant in respect of improvements or reconstruction works connected with small docks and harbours which can be put in hand by January 1, 1931.

In view of the special facilities granted by the Argentine Government for the prompt dispatch of goods specially consigned for the British Empire Exhibition at Buenos Aires from March 14 to April 27, the River Plate Conference Lines have agreed to waive the customary surcharge of 5s. a ton on all exhibits shipped to that port. This concession by the shipping companies follows the granting by the Argentine Government of a series of special privileges in respect of Customs duty, licensing and taxation.

The London & North Eastern Railway Company announce that a scheme for the improvement of the crane equipment at Middlesbrough Dock will be begun before the end of this month. Of the 42 cranes at present in operation, 39 are to be replaced by new electrically-driven two-gear cranes. Seven additional cranes of the same type will be provided. The improved cranes will greatly facilitate the loading of cargo, which, owing to the increasing size of vessels, has become a difficult matter with the fixed-jib cranes.

The Standing Committee appointed by the Board of Trade will hold an inquiry under the Merchandise Marks Act at 11.30 a.m. on Monday, October 20, and at 10.30 a.m. on Tuesday, October 21, as to whether imported goods of the following descriptions should be required to bear an indication of origin:—(*a*) Electricity meters which register by integration over a period of time the consumption or quantity of electricity used in any electric circuit; and (*b*) the following parts of such meters, namely, the case, the rotor, the shunt system, and the series system. The inquiry will be held at the Board of Trade Offices, Great George Street, S.W.1. Communications should be addressed to the secretary, Mr. E. W. Reardon, at that address.

Speaking after the launch at Walker last week of the single-screw tank motorship "Gylfe," built for Norwegian owners, Mr. James Stewart, managing director of Messrs. Sir W. G. Armstrong, Whitworth & Company (Shipbuilders), Limited, said the few prospective orders that came on to the market from time to time were being taken by foreign shipbuilders, who, very often with subventions from their respective Governments, were enabled to accept prices which could not be contemplated in this country. This was one kind of unfair competition that they had to face in shipbuilding. They had recently seen orders for nine large American tankers to the value of about £2¾ million sterling go to Germany and Italy. It seemed to him that some scheme could be devised by the Government to help shipbuilding in this country.

Among induction-furnace equipments recently ordered from the Metropolitan-Vickers Electrical Company, Limited, is one for non-ferrous work, to the order of Messrs. Hopkinsons, Limited, Huddersfield, makers of steam valves and boiler fittings. The equipment is to be installed in the firm's "Platnam" foundry, where special alloys are melted for this work. The furnace to be supplied is of the Metropolitan-Vickers standard type and of ¼-ton capacity, designed to melt its full charge in one hour from cold. The furnace proper is contained in a steel case, which is equipped with motor-driven tilting gear. The supply of power to the furnace is provided by means of a motor-generator set. The equipment will include condensers for power-factor correction and equipment for automatic voltage control. This latter provision is of importance in that it leaves the operator free to concentrate his attention on the metallurgical considerations of the work.

The statement that the Soviet Government was negotiating for the placing of shipbuilding and machinery contracts on the Clydeside valued at £5,000,000 was made to the Press last week by Mr. R. J. Kroumowitz, vice-chairman of Metalloimport, Moscow, who has arrived in Glasgow. Mr. Kroumowitz said that he had been in direct contact with Messrs. Harland & Wolff, Limited, Glasgow, and if credit terms suitable to the Soviet Government and the Govan yard could be arranged, this yard would get a large share of the work which Russia intended to place. Messrs. John Brown & Company, Limited, Alexander Stephen & Sons, Limited, and the Fairfield Shipbuilding & Engineering Company, Limited, would also be interviewed. Mr. Kroumowitz said that at the present moment they were negotiating with Messrs. Mavor & Coulson, Limited, who had already supplied them with a number of coal-cutters. In addition, they were going to approach the Scottish rolling mills and the foundry firms.

Contracts Open.

Belfast, October 15.—Three electrically-driven pumps, for the Belfast Harbour Commissioners. Mr. W. Y. Chamberlain, acting chief engineer, Harbour Office, Belfast.

Birkenhead, September 25.—Bolts, nuts, nails, screws, sheet lead, piping, metals and wrought-iron piping, for the Mersey Railway Company. Mr. J. Shaw, general manager and secretary.

Cumwhinton and Carlisle, September 29.—4¼ miles of cast-iron pipes, etc., for the Corporation of Carlisle. Mr. P. Dalton, city water engineer, 18, Fisher Street, Carlisle. (Fee £2 2s., returnable.)

Settle, September 22.—3,540 yds. of spun-iron pipes and 300 yds. of cast-iron pipes, etc., for the Settle Rural District Council. Mr. F. J. Rowdell, engineer, 37 and 38, Prudential Buildings, Park Row, Leeds. (Fee £2 2s., returnable.)

Reports and Dividends.

Bede Metal & Chemical Company, Limited.—Interim dividend of 6¼ per cent.

Canada Iron Foundries, Limited.—Dividend of $1½ per share on the common shares.

British Aluminium Company, Limited.—Interim dividend of 4 per cent. on the ordinary shares.

Central Provinces Manganese Ore Company, Limited.—Interim dividend of 7½ per cent., tax free.

Sheffield Forge & Rolling Mills Company, Limited.—Loss for the year of £2,580, increasing the deficiency brought forward to £63,283.

Coventry Gauge & Tool Company (1928), Limited.—Trading profit, £27,684; dividend of 5 per cent.; written off preliminary expenses, £4,500; carried forward, £740.

Stewarts & Lloyds, Limited.—Interim dividend for the half-year ended June 30 of 6 per cent. per annum on the preference shares and at the rate of 10 per cent. per annum on the preferred ordinary shares.

Personal.

Mr. W. W. Butler, President of the Canada Car & Foundry Company, Limited, arrived in this country last week.

Mr. Arthur Henry Stockley has joined the board of Messrs. Cammell Laird & Company, Limited, Birkenhead.

Mr. William Francis Campbell McClure and Mr. John Charles Lloyd have been appointed directors of Messrs. Stewarts & Lloyds, Limited, Glasgow.

Mr. H. Thompson has been appointed commercial manager of the Barrow shipyard of Messrs. Vickers-Armstrongs, Limited, in place of the late Mr. W. E. Pritchard.

Wills.

Good, W. H., a director of Messrs. Kerr, Stuart & Company, Limited, Stoke-on-Trent £2,249

Keighley, Gilbert, jun., a director of Messrs. George Keighley, Limited, engineers and ironfounders, Burnley £3,209

Chandler, F. H., joint managing director of Messrs. Wright, Bindley & Gell, Limited, of Percy Road, Greet, Birmingham £6,856

Booth, S., a director of Messrs. T. Rowbotham & Company, Limited, of Victoria Engineering Works, Stockport, brassfounders and engineers £31,213

Obituary.

The death occurred last Wednesday week, at Augsburg, Germany, of Mr. Alfred F. Ridley, who was well known internationally as an inspector of ferrous products for British consulting engineers. During the war Mr. Ridley was attached to the Ministry of Munitions.

Mr. Charles Ricard, senior partner in Messrs. Ricard & Freiwald, metal merchants, of London, died last week. Born in Holland 70 years ago, Mr. Ricard came to London in the late 'nineties, and established the present business with his partners, Mr. Freiwald and Mr. Arle, both of whom have predeceased him. Mr. Ricard was a recognised leader of the tin market.

Lieut.-Commander W. H. Reynolds, R.D., R.N.R. (retired), who was well known in engineering circles in South Wales and the West of England, died at Cardiff recently, in his 59th year. Mr. Reynolds had represented Messrs. Babcock & Wilcox, Limited, in South Wales and the West of England, with headquarters in St. Mary Street, Cardiff, for 21 years. He was joint hon. secretary, with Professor Bacon, of the South Wales Branch of the Institute of Mechanical Engineers, and was a past-chairman of the branch. He was also an active member of the South Wales Institute of Engineers, and since its inception had worked with enthusiasm for the success of the engineering exhibition held annually at Cardiff under the auspices of the Institute.

New Companies.

Manington's, Limited, 426, Canterbury Street, Gillingham, Kent.—Capital £2,500. Engineers, etc. Directors: L. E. and E. J. Manington.

A. W. Creasey & Company, Limited, 98-100, Ilford Lane, Ilford.—Capital £1,500. Engineers, etc. Directors: D. R. Sleap and W. F. Athill.

Ferexpor (London), Limited, 12, Norfolk Street, London, W.C.—Capital £500. Iron and steel merchants, etc. Directors: M. Klang, J. B. Chambers and R. Amat.

B. B. Price, Limited.—Capital £2,000. Manufacturers of spikes, bolts and nuts, etc. Directors: P. Withers, 1, Birmingham Street, Halesowen; B. B. Price and Elizabeth B. Price.

Tungum Alloy Company, Limited, 150, Southampton Row, London, W.C.—Capital £300. Metal alloy manufacturers, etc. Directors: G. Dearle, N. Leith-Hay Clark and A. Carter.

W. S. Tyler Company, Limited, 21, Leadenhall Street, London, E.C.—Capital £2,000. Dealers in metal work, etc. Directors: C. J. Wilkinson, A. J. M. Duncan and J. I. Pickering.

P. R. Jackson & Company, Limited, Salford Rolling Mills, Hampson Street, Manchester.—Capital £100. Steel and iron founders, engineers, etc. Directors: W. J. Davy, J. W. J. Walker, C. Davy and W. S. Davy.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Although conditions in the Cleveland iron market still continue rather unsettled, it is, at all events, satisfactory to report a slightly improved demand on home consumers' account and a distinct inclination on the part of buyers to extend their scope of operations in forward purchasing. This fact is emphasised in the case of many founders and engineers, who have hitherto been working on very narrow margins. Now, when prices appear to be stabilised at a lower level, there is a disposition to exercise a little less restraint in regard to pig-iron purchases. Sales to Scotland are still limited, even though Cleveland iron is being delivered in that area at an inclusive figure which is well below the recognised minimum to other consumers f.o.t. Middlesbrough. Moreover, Midlands and foreign iron is still coming to Tees-side for local consumption. There is, however, more inquiry for local iron, and makers are hopeful that a speedy reduction of stocks may be effected. Quotations may be repeated as follow:—No. 1 Cleveland foundry iron, 66s.; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; No. 4 forge, 62s. per ton.

It is of interest to note that the market for East Coast hematite has of late achieved a greater measure of stability than at any previous period this year. From January to August prices had been steadily falling, but no alteration has been made in the recognised market quotation for hematite for some time past, and this state of equipoise is creating a feeling of greater confidence. The price still ruling is 71s. for mixed numbers, with No. 1 quality marked 6d. per ton extra. On the North-West Coast Bessemer mixed numbers are also firm at 70s. per ton at works.

LANCASHIRE.—Many of the foundries in the Manchester district continue only moderately busy, and consequently local markets for pig-iron are undergoing comparatively quiet times. The majority of the orders for pig-iron recently placed have been for relatively early delivery, although in the aggregate the quantity affected has been a shade heavier than before, with delivery specifications, also, relating to somewhat heavier tonnages. Prices are unchanged as follow:—No. 3 Staffordshire and Derbyshire, 72s., with Scottish brands at about 93s., all per ton, delivered local stations.

THE MIDLANDS.—Throughout the Black Country districts there is still an insufficiency of orders to maintain the foundries in full work, and pig-iron consumers, therefore, continue to purchase only on a limited scale. Markets are, consequently, lacking in interest, with prices stationary all round, the ruling rates being:—No. 3 Northants, 70s.; No. 3 Derbyshire, 73s. 6d.; No. 3 Staffordshire, 73s. 6d.; with Scotch foundry 93s. 6d. to 97s.; all per ton delivered local stations.

SCOTLAND.—Markets for Scotch pig-iron continue depressed, business being extremely quiet in the foundries, many of which experience difficulty in obtaining orders to keep their plants going. The current quotation, however, remains unchanged on the basis of 76s. 6d. for No. 3 foundry, f.o.t. furnaces.

Finished Iron.

The Birmingham market for bar iron does not evidence any improvement, and neither consumers nor stockholders are ordering any appreciable quantities at the present time of crown quality. The mills are in an unsatisfactory position, and are quite unable to gather up sufficient business to maintain continuity of operation. The prices of the various grades are unchanged, with crown iron from £10 to £10 5s., nut and bolt iron £9 to £9 5s., and Staffordshire marked bars £12 10s. at works. There is very keen competition for any available business in crown or bolt iron, but the marked-bar makers have no difficulty in getting their price, and, fortunately, orders for this quality keep up to a fairly satisfactory level. The absence of support to the ironworks for nut and bolt iron is due almost entirely to the low prices ruling for foreign material.

Steel.

In the Sheffield steel market matters are a little better, but demands are easily met. Soft basic billets are an improving feature, but acid billets continue to be in poor demand. No price changes in billets have yet been made. There is a fair demand for strip, but wire-rod sales are not encouraging. Prices are unchanged. A big proportion of the open-hearth steel furnaces in this district is still idle, and those operating are fully equal to meeting the demand. Crucible-steel makers are only moderately employed, but manufacturers of the costly high-grade steels are fairly busy. The push in the motor-car trade is expected to benefit Sheffield, which produces big quantities of the steel required in car construction. The market for tinplates continues quiet and easy, with the current quotation still ruling at 18s. basis for coke quality, net cash, f.o.b. Welsh ports.

Scrap.

Business in the various markets for foundry scrap materials gives no sign at present of early improvement, and prices everywhere seem to indicate a still lower tendency. On Tees-side, although the demand for heavy cast iron is little better, the merchants decline to cut prices any further, and ordinary quality remains at 55s., with machinery quality at 57s. 6d. In the Midlands, there is still a fair demand for cast-iron scrap for use in local foundries. For heavy machinery cast-iron scrap, broken in cupola sizes, 65s. has been realised. Light cast-iron scrap is weak at 50s. delivered.

In Scotland, heavy machinery cast-iron scrap, suitable for foundries, is quoted at around 63s., ordinary cast iron to the same specification at 57s., old railway chairs 58s. 6d., and light metal 45s. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Although values of warrant copper recovered to some extent, a subsequent relapse brought the figures again to lower levels at the close. The position is now so much dependent on the movements of the American producers in reducing stocks that it would be futile to prophesy an early return to more normal conditions. As long as refinery stocks remain at about three times a normal quantity there is little inducement to buyers to do more than cover immediate requirements.

Closing quotations :—

Cash.—Thursday, £47 6s. 3d. to £47 7s. 6d.; Friday, £47 8s. 9d. to £47 10s.; Monday, £47 to £47 1s. 3d.; Tuesday, £46 5s. to £46 6s. 3d.; Wednesday, £46 2s. 6d. to £46 3s. 9d.

Three Months. — Thursday, £47 10s. to £47 11s. 3d.; Friday, £47 8s. 9d. to £47 10s.; Monday, £46 17s. 6d. to £46 18s. 9d.; Tuesday, £46 6s. 3d. to £46 7s. 6d.; Wednesday, £46 2s. 6d. to £46 3s. 9d.

Tin.—Continuing almost stationary over the past week, standard tin values, towards the close, moved slightly upward, evidencing a tendency to improve. But until stocks in this country show signs that the long-continued increase has come to an end, confidence in the statistical position cannot be expected to return. This huge accumulation in English warehouses holds a constant threat over values, and since months must elapse before any reduction is seen, the outlook is not very bright for any advance in the price of tin.

Official closing prices :—

Cash.—Thursday, £134 10s. to £134 12s. 6d.; Friday, £134 7s. 6d. to £134 10s.; Monday, £133 17s. 6d. to £134; Tuesday, £134 5s. to £134 7s. 6d.; Wednesday, £134 to £134 2s. 6d.

Three Months. — Thursday, £136 7s. 6d. to £136 10s.; Friday, £136 2s. 6d. to £136 5s.; Monday, £135 7s. 6d. to £135 10s.; Tuesday, £135 17s. 6d. to £136; Wednesday, £135 12s. 6d. to £135 15s.

Spelter.—The market for spelter has improved slightly, but there is very little demand at present either from the galvanisers or brass makers, and until a definite announcement regarding curtailment of production is forthcoming, it seems impossible for the quotation to go much above £16 spot. Statistically the situation is still unfavourable.

Daily fluctuations :—

Ordinary.—Thursday, £16; Friday, £15 18s. 9d.; Monday, £15 18s. 9d.; Tuesday, £15 18s. 9d.; Wednesday, £15 18s. 9d.

Lead.—Slowly, but surely, the low price is forcing the high-cost producers to suspend operations, but for all that anything in the way of a marked advance in the quotation is not expected at present, and a considerable time must elapse before the situation can improve sufficiently to support a higher price.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £18 5s.; Friday, £18 3s. 9d.; Monday, £18 3s. 9d.; Tuesday, £18 1s. 3d.; Wednesday, £17 16s. 3d.

Continental Steel Cartel.

According to statistics now available, the production of the national groups embodied in the Continental Steel Cartel in the first half of the current year amounted to 15,470,500 tons, as compared with 18,020,927 tons in the first half of last year, the diminution being due to the unfavourable situation of the world market, which promises to become worse in the current half-year. With the exception of France, all the other three groups show lower results than in the first half of 1929. Germany has suffered the most from the decline. Her production has decreased from 8,823,800 tons in the first half of 1929 to 6,581,000 tons in the first six months of this year; the output of the Saar works has fallen from 1,087,400 tons to 1,042,600 tons; that of Belgium from 1,980,000 tons to 1,822,000 tons; and that of Luxemburg from 1,315,727 tons to 1,194,000 tons. On the other hand, the French production has increased from 4,814,000 tons to 4,830,000 tons.

In connection with the penalties for excess output and compensations for short output, the German group will this time receive a definite amount out of the equalisation fund, whereas France will have to pay into the fund a small amount for exceeding her production. In considering the above figures it should be remembered that in October, 1929, the production of all the groups was reduced by 10 per cent. in order in some measure to adjust the output to the absorbing capacity of the world markets.

The naval shipbuilding establishment of Messrs. William Beardmore & Company, Limited, at Dalmuir, on the Clyde, will cease to exist shortly, the yard having been purchased by the National Shipbuilders' Security, Limited, the rationalisation company formed by British shipbuilders six months ago, with a nominal capital of £10,000, subscribed by the shipbuilding companies, but with borrowing powers up to £3,000,000 and the support of banking authorities. As the principal object of the National Shipbuilders' Security, Limited, is the purchase of redundant shipyards, the dismantling and disposal of their contents, and the re-sale of the sites under restrictions against further use for shipbuilding, this purchase of the shipyard at Dalmuir means the end of shipbuilding there, although work in the other branches of Messrs. Beardmore at Dalmuir—the marine and general engineering works—will still continue. But no more ships can be laid down on the berths. The Dalmuir shipyard, which will complete the small amount of work now on hand, is expected to be closed by the end of 1930. Negotiations between the National Shipbuilders' Security, Limited, and two other shipyards, one on the West Coast of Scotland and the other on the East Coast of England, are in progress. A statement issued by Messrs. William Beardmore & Company, Limited, after announcing the sale, says that this step has been taken in view of the post-war curtailment of warship work and the absence of an adequate volume of the high-class mercantile work for which the yard was suitable, and in order to permit of a concentration of the company's resources on the development of the marine and general engineering work at Dalmuir; at their forge and steelworks at Parkhead; and on the other branches elsewhere of the heavy industries in which they still hold a leading position.

GREAT ECONOMY!

ONE of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX.

The result will be economy all round.

Your moulders will put down more moulds per day because STERLING BOXES are light and easy to handle;

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Glasgow: ALBERT SMITH & CO., 60, ST. ENOCH SQUARE, GLASGOW, C.1.
Newcastle-on-Tyne: LAWSON, WALTON & CO., LTD., HANDYSIDE ARCADE, NEWCASTLE-ON-TYNE.
Manchester: F. L. HUNT & CO., CHAPEL STREET, SALFORD, MANCHESTER.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	46	2	6
Three months	46	2	6
Electrolytic	49	0	0
Tough	48	10	0
Best selected	49	0	0
Sheets	79	0	0
India	63	0	0
Wire bars	51	0	0
Do. October	51	0	0
Do. November	51	0	0
Ingot bars	51	0	0
H.C. wire rods	53	10	0
Off. av. cash, August	47	11	4½
Do., 3 mths., August	47	12	5½
Do., Sttlmnt., August	47	11	3
Do., Electro, August	51	4	6
Do., B.S., August	50	14	8¾
Do., wire bars, August	51	14	6
Solid drawn tubes			11½d.
Brazed tubes			11½d.
Wire			8½d.

BRASS.

Solid drawn tubes	10½d.
Brazed tubes	12½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	6½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8½d.
Yellow metal rods	6½d.
Do. 4 × 4 Squares	7d.
Do. 4 × 3 Sheets	7½d.

TIN.

	£	s.	d.
Standard cash	134	0	0
Three months	135	12	6
English	135	0	0
Bars	137	5	0
Straits	136	2	6
Australian	135	7	6
Eastern	138	2	6
Banca	138	5	0
Off. av. cash, August	135	1	2¼
Do., 3 mths., August	136	14	6¾
Do., Sttlmt., August	135	1	6

SPELTER.

	£	s.	d.
Ordinary	15	18	9
Remelted	14	15	0
Hard	12	5	0
Electro 99.9	18	2	6
English	16	7	6
India	14	5	0
Zinc dust	22	0	0
Zinc ashes	4	0	0
Off. aver., August	16	4	2⅝
Aver., spot, August	15	19	0¼

LEAD.

	£	s.	d.
Soft foreign ppt.	17	16	3
English	19	10	0
Off. average, August	18	4	8⅝
Average spot, August	18	5	10½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	26	0	0
Do. V.M. ex-whf.	25	0	0
Rods	30	0	0
Boiler plates	21	0	0
Battery plates	22	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	38	0	0
Chinese	27	0	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£11 10 0
75%	£18 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£16 0 0
Ferro-tungsten—	
80/85%	2/3 lb.
Tungsten metal powder—	
98/99%	2/6 lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 10 0
6/8% car.	£22 7 6
8/10% car.	£22 0 0
Ferro-chrome—	
Max. 2% car.	£33 10 0
Max. 1% car.	£37 15 0
Max. 0.70% car.	£42 7 6
70% carbon-free	11d. lb.
Nickel—99% cubes, or pellets	£175 0 0
Ferro-cobalt	9/7 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0 to £11 15 0
76/80% packed	£12 0 0 to £12 15 0
76/80% export	£10 10 0 to £11 0 0
Metallic manganese—	
94/96% carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 2
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy steel				2	15	0
Bundled steel and shrngs.				2	10	0
Mixed iron and steel				2	10	0
Heavy cast iron	2	13	6 to	2	15	0
Good machinery for foundries	2	15	0 to	2	17	6
Cleveland—						
Heavy steel				2	7	6
Steel turnings				1	17	6
Cast-iron borings				1	12	6
Heavy forge				3	5	0
W.I. piling scrap				3	1	6
Cast-iron scrap	2	15	0 to	2	17	6
Midlands—						
Ord. cast-iron scrap				2	10	0
Heavy wrought				2	17	6
Steel turnings	1	7	6 to	1	10	0
Scotland—						
Heavy steel				2	12	6
Ordinary cast iron				2	17	0
Engineers' turnings				1	15	0
Cast-iron borings				1	12	6
Wrought-iron piling				3	7	6
Heavy machinery				3	3	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	41	0	0
Brass	31	0	0
Lead (less usual draft)	16	5	0
Tea lead	12	15	0
Zinc	9	0	0
New aluminium cuttings	56	0	0
Braziery copper	38	0	0
Gunmetal	41	0	0
Hollow pewter	100	0	0
Shaped black pewter	75	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	66/-
Foundry No. 3	63/6
Foundry No. 4	62/6
Forge No. 4	62/-
Hematite No. 1	71/6
Hematite M/Nos.	71/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	80/-
„ d/d Birm.	88/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	68/6
„ No. 3 fdry.*	73/6
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	65/-
„ fdry. No. 3*	70/-
Derbyshire forge*	68/6
„ fdry. No. 3*	73/6
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	78/-
Sheffield (d/d district)—	
Derby forge	63/6
„ fdry. No. 3	68/6
Lincs. forge	—
„ fdry. No. 3	70/-
E.C. hematite	83/6
W.C. hematite	86/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	67/-
„ fdry. No. 3	72/-
Staffs foundry No. 3	72/-
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	93/-
Glengarnock, No. 3	—
Eglinton, No. 3	93/-
Gartsherrie, No. 3	93/-
Monkland, No. 3	93/-
Shotts, No. 3	93/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	10	0	0 to	10	15	0
Nut and bolt iron	9	0	0 to	9	5	0
Hoops	10	15	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip	10	15	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates	8	15	0 to	8	17	6
Boiler plts.	9	15	0 to	10	10	0
Chequer plts.				10	12	6
Angles				8	7	6
Tees				9	7	6
Joists				8	10	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¼ in. (Untested)				7	15	0

and upwards

Flats—8 in. wide and over	8 12 6
„ under 8 in. and over 5 in.	8 17 6
Rails, heavy	8 10 0
Fishplates	12 0 0
Hoops (Staffs)	9 5 0 to 9 15 0
Black sheets, 24 g.	9 12 6 to 9 15 0
Galv.cor.shts., 24g.	11 17 6
Galv. fencing wire, 8g. plain	12 0 0
Billets, soft	5 15 0 to 6 5 0
Billets, hard	7 10 0 to 8 0 0
Sheet bars	5 15 0 to 6 0 0
Tin bars	6 0 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/0½
Sheet to 10 w.g.	1/1½
Wire	1/1¾
Rods	1/1
Tubes	1/5½
Castings	1/1½

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.76
No. 2 foundry, Valley	18.00
No. 2 foundry, Birm.	14.00
Basic	19.76
Bessemer	20.26
Malleable	20.26
Grey forge	19.26
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	31.00
Sheet bars	31.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.70
Skelp, sheared steel	1.70
Steel hoops	1.95
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.00
Sheets, blue an'l'd, No. 13	2.05
Wire nails	2.00
Plain wire	2.30
Barbed wire, galv.	2.70
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	25/- to 27/6
„ furnace	17/6 to 21/6
Durham and Northumberland—	
„ foundry	15/- to 15/6
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		18/-
„	28×20 „		36/-
„	20×10 „		26/-
„	18½×14 „		18/9
C.W.	20×14 „		16/-
„	28×20 „		33/6
„	20×10 „		23/6
„	18½×14 „		17/-
Terneplates	28×20		32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Sept.	11 ..	47	6	3	dec.	1/3
,,	12 ..	47	8	9	inc.	2/6
,,	15 ..	47	0	0	dec.	8/9
,,	16 ..	46	5	0	,,	15/-
,,	17 ..	46	2	6	,,	2/6

Electrolytic Copper.

		£	s.	d.		
Sept.	11 ..	50	10	0	No change	
,,	12 ..	50	10	0	,,	,,
,,	15 ..	50	0	0	dec.	10/-
,,	16 ..	49	0	0	,,	20/-
,,	17 ..	49	0	0	No change	

Standard Tin (cash).

		£	s.	d.		
Sept.	11 ..	134	10	0	inc.	15/-
,,	12 ..	134	7	6	dec.	2/6
,,	15 ..	133	17	6	,,	10/-
,,	16 ..	134	5	0	inc.	7/6
,,	17 ..	134	0	0	dec.	5/-

Tin (English ingots).

		£	s.	d.		
Sept.	11 ..	135	15	0	inc.	15/-
,,	12 ..	135	15	0	No change	
,,	15 ..	135	5	0	dec.	10/-
,,	16 ..	135	5	0	No change	
,,	17 ..	135	0	0	dec.	5/-

Zinc Sheets (English).

		£	s.	d.		
Sept.	11 ..	26	0	0	No	change
,,	12 ..	26	0	0	,,	,,
,,	15 ..	26	0	0	,,	,,
,,	16 ..	26	0	0	,,	,,
,,	17 ..	26	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Sept.	11 ..	16	0	0	inc.	1/3
,,	12 ..	15	18	9	dec.	1/3
,,	15 ..	15	18	9	No change	
,,	16 ..	15	18	9	,,	,,
,,	17 ..	15	18	9	,,	,,

Lead (English).

		£	s.	d.		
Sept.	11 ..	19	10	0	No change	
,,	12 ..	19	10	0	,,	,,
,,	15 ..	19	10	0	,,	,,
,,	16 ..	19	10	0	,,	,,
,,	17 ..	19	10	0	,,	,,

Exports of Iron Castings in August and the eight months 1930, compared with August and the eight months 1929.

	August, 1929.	August, 1930.	Eight months, 1929.	Eight months, 1930.	August, 1929.	August, 1930.	Eight months, 1929.	Eight months, 1930.
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, grates, etc., cisterns, baths, etc., and cooking and washing boilers—								
To Argentine Republic	100	120	1,365	1,435	5,114	4,246	63,204	63,123
,, British South Africa	270	178	2,385	1,578	9,944	7,120	85,390	62,120
,, ,, India	121	110	1,132	1,043	5,056	4,048	43,871	38,472
,, Australia	49	5	491	236	2,476	137	27,903	13,662
,, New Zealand	114	73	931	700	5,419	4,452	57,999	41,000
,, Other Countries	797	897	6,717	6,798	36,674	41,182	307,208	306,465
Total	1,451	1,383	13,021	11,790	64,683	61,185	585,575	524,842
PIPES AND FITTINGS—CAST—								
To Argentine Republic	2,298	833	18,195	10,809	20,098	9,317	170,948	106,749
,, British South Africa	382	866	4,605	5,722	5,964	7,539	61,154	62,708
,, ,, India	397	154	3,197	2,176	5,079	2,515	43,076	33,611
,, Straits Settlements and Malay States	764	2,196	15,522	6,878	5,747	16,475	113,027	58,360
,, Ceylon	277	258	1,509	1,168	2,589	2,025	15,428	11,227
,, Australia	100	31	2,851	592	1,675	625	31,206	10,883
,, Other countries	6,651	7,394	41,423	54,916	78,338	76,594	506,419	621,655
Total	10,869	11,732	87,302	82,261	119,490	115,090	941,258	905,193
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	467	256	3,178	2,722	15,605	9,429	114,067	89,322
,, Enamelled	93	52	621	534	8,354	5,064	55,618	46,850
CASTINGS, in the rough—								
Iron	104	210	1,028	1,660	4,162	7,093	37,399	51,435
Steel	191	111	857	1,409	7,566	5,614	35,383	57,606

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

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ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

SITUATIONS VACANT AND WANTED.

FOUNDRYMAN (young) seeks position as Foreman or Assistant; first-class experience in all departments; accept anything in foundry trade.—Apply, Box 616, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager, disengaged; good organiser; experienced in mixing of metals, cupola practice, and piece-rate fixing; light or heavy casting.—Box 602, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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